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ABSTRACT

This curriculum guide has been developed as a resource for teachers (especially in North Carolina) to use in planning and implementing a competency-based instructional management technology program in their schools. The guide contains three main section. The first section contains introductory materials and a course blueprint that lists the competencies the student is to attain and time guidelines for a one-semester course. The second section contains five units of instruction that contain detailed information directly correlated to the blueprint and test-item bank. The units explain in more detail what information or behavior the student is expected to acquire. They list the resources and page numbers on which more detailed information can be found and offer suggested learning activities and strategies. The five units cover the following topics: (1) introduction; (2) fundamental scientific and technical concepts and principles; (3) historical developments of transportation systems; (4) vehicular systems and subsystems; and (5) transportation occupational opportunities. The third section (appendixes) contains a bibliography and reference section listing 15 references; a vendors' address list for texts, literature, and films; an equipment list; and a VoCATS (Vocational Competency Achievement Tracking System) test-item bank and tests. (KC)

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TRANSPORTATION SYSTEMS

TE8126

TECHNOLOGY EDUCATION

Public Schools of North Carolina
State Board of Education - Jay Robinson, Chairman
Department of Public Instruction - Bob Etheridge, State Superintendent

Vocational and Technical Education Services
July 1995

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July 1995

Public Schools of North Carolina
State Board of Education
Department of Public Instruction
Office of Instructional and Accountability Services
Division of Instructional Services

TABLE OF CONTENTS

Page

Section I

Foreword . . . . . .

Introduction . . . . . .

Acknowledgments vi

Using the Curriculum Guide vii

Course Blueprint ix

Section II

Units of Instruction

Unit A: Introduction 1

Unit B: Fundamental Scientific and Technical Concepts and Principles 10

Unit C: Historical Developments of Transportation Systems . 15

Unit D: Vehicular Systems and Sub-systems . . . 18

Unit E: Transportation Occupational Opportunities . . . 38

Section III

Appendices

A. Bibliography / References A-1

B. Vendor's Addresses for Texts, Literature, and Films . . . B-1

C. Equipment List C-1

D. VoCATS Transportation Systems Test-item Bank . . . D-1

Section I

ACKNOWLEDGMENTS

This guide is dedicated to Dr. Eddie Butler whose fine service to the students and teachers of North Carolina will always be felt.

The Division of Instructional Services and the Technology Education staff wish to give special thanks to the individuals who spent many hours developing the Transportation Systems course. The process included a review of international literature, review of suggestions offered by teachers and administrators from throughout the state, and many hours spent in constructive debate and discussion.
Two teams were involved. The first team designed the course (blueprints, and curriculum guide, references, resources, and equipment list). Membership of the first team contained the following members:

Aaron Clark	Doctoral Student, TE	NCSU
Mike Hinshaw	Technology Teacher	East Randolf H.S.
Wanda Jackson	Technology Teacher	New Hanover H.S.
Wayne Miller	Technology Teacher	South Stokes H.S.
Tom Shown	Technology Consultant	NCDPI

The second team wrote the test-items which make up the Transportation Systems test-item bank. The following were the test-item team members:

Aaron Clark	Doctoral Student, TE	NCSU
Deborah Levin	Textile Eng. Graduate	NCSU
Tom Shown	Technology Consultant	NCDPI

Special thanks is also extended to the N.C. Technology Education Curriculum Advisory Board who freely gave their time to help us produce the highest quality curriculum materials possible. Throughout the developmental process they contributed to the making of a curriculum which would have been of much lesser quality without their collective insights, suggestions and direction. The board was comprised of the following members:

Don Ball	English Teacher	Wake Technical Community College
Dr. Elazer Barnette	Professor	NCA&T
Kathleen Barrows	Technology Teacher	Clinton H.S.
David Crane	Technology Teacher	Douglas Byrd H.S.
Deborah Hartman	Technology Teacher	Philo M.S.
Dr. Jim Haynie	Professor	NCSU
Wanda Jackson	Technology Teacher	New Hanover H.S.
Dr. Robert Pierce	Professor	Elizabeth City State University
Dr. Kenneth Volk	Professor	NCECU

Finally, we extend our thanks to the teachers, directors, and others who have taken their time to critique our progress and offer suggestion during this process. Our work is better for their effort.

Debbie Barber	Secretary	NCDPI
Deborah Shumate	Consultant, TE	NCDPI
Tom Shown	Consultant, TE	NCDPI

Using the Curriculum Guide

Purpose

The Transportation Systems Curriculum Guide has been developed as a resource for teachers to use in planning and implementing a competency-based instructional management technology program in their school. This guide is one tool used in the VoCATS process.

Description

Transportation Systems has been designed to be a semester in length. The following description is from the North Carolina Vocational and Technical Education Programs of Studies and Support Services Guide:

> Transportation Systems introduces the student to the history and modes of transportation through experimentation and model making. Land, water, air, space, and intermodal transportation systems are explored with hand-on activities emphasizing relevant scientific and engineering concepts. Activities include defining problems, designing prototypes, using computer assisted applications, constructing models, and testing prototypes and using appropriate tools such as wind tunnels and performance tests. The course was designed for students pursuing technical or engineering careers in transportation related areas or individuals who like creating model rockets, planes, cars, and water vehicles.

General Instruction

This course may be taught using individualized, whole class, team, or a combination of each strategy. Regardless of which method is used, it is essential that the activities reflect the competencies and objectives of the course.

The course demands much from the student and teacher in terms of its complexity of materials and brevity of time in which the materials are to be mastered. Because of time limitations and the amount of material to be covered, one can not teach objectives as discrete units of instructions. Objectives must be taught concurrently within the larger context of an activity. Not only does this method address the need for the efficient use of time, but it is reflective of good pedagogy and reflects the way we teach. (This newest edition of the course reflects the effort of our team in reducing the amount of information to be covered by the students and teacher. It also reflect a refocusing on essential information).

Since Transportation Systems is an activity centered curriculum with competencies and objectives to be mastered, it is important that the teacher use activities which collectively address all the course objectives.

Blueprint

The blueprint (See the Transportation Systems Blueprint on the following pages) lists the competencies the student is to attain. Competencies are mastered when a student masters the objectives which make up the competency.
Suggested time in hours is offered as a general rule-of-thumb for teachers to use in planning.
Course weight is the degree of importance given to each objective in relation to the entire course of study. This in turn will determine the number of test-items per objective on any test developed by the state department.

Using the Curriculum Guide

Units of Instruction

The Units of Instruction section is designed to give the teacher detailed information directly correlated to the blueprint and test-item bank. It attempts to explain in more detail what information or behavior the student is expected to know or do. It lists the resource and page number on which more detailed information can be found. This section also offers suggested activities and strategies.

Bibliography/References (Appendix A)

This section provides the author(s) name of text, and publisher of the references listed within the Units of Instruction "Resources" column.

Vendor's Addresses for Texts, Literature, and Films (Appendix B)

All texts, literature, software, and videos may be purchased through one of the resources listed.

Equipment List (Appendix C)

The equipment list gives the minimum number of tools, equipment, and software necessary for the instruction of Transportation Systems. If you have any questions regarding any aspect of this course, including equipment needs, please call one of your technology consultants.

VoCATS Test-Item Bank and Tests (Appendix D)

You should have access to the Transportation Systems Test-item Bank which will be released August 1995. This bank is made up of multiple choice test items and performance test-items. Under the "Attribute" section of each test-item will be found the exact text and page number of the information used to write the test-item. Appendix D contains a hard copy of all the bank test-items. Note that the last page of this appendix contains a formula sheet for students to use when computing questions within the bank.

TECHNOLOGY EDUCATION
COURSE BLUEPRINT for 8126 (CIP# 21 0101): TRANSPORTATION SYSTEMS
(Course Length: 1 semester; Class Length: 1 period)

Comp# Obj.#	Unit Titles / Competency and Objective Statements (The student will be able to:)	TIME Hrs.	UNIT Weight	COURSE Weight	Type Behavior	Integrated Skill Area	Core Supp
1	2	3	4	5	6	7	8
	COURSE			100%			
A	**INTRODUCTION**	14.0	100%	16%			
001.	**Assess the role and importance of transportation systems to society.**	6.0	36%	6%	C3	SS	Core
001.01	Define transportation systems and explain their importance to society.	2.0	12%	2%	C3	SS	Core
001.02	Identify and define the four major modes of transportation and their intermodal relationship.	2.0	12%	2%	C1	SS	Core
001.03	Identify and define the five major transportation vehicular systems.	2.0	12%	2%	C1	SS	Core
002.	**Participate in a responsible and efficient manner as an individual or group member to plan, organize, and carry out activities and projects.**	8.0	64%	10%	C3P	H/C	Core
002.01	Identify and explain management skills and quality tools.	2.0	12%	2%	C3	C	Core
002.02	Apply management skills and quality tools effectively.	2.0	20%	3%	C3P	C	Core
002.03	Explain classroom and lab safety rules and procedures.	2.0	12%	2%	C1	H	Core
002.04	Apply classroom and lab safety rules and procedures appropriately.	2.0	20%	3%	C3P	H	Core
B	**FUNDAMENTAL SCIENTIFIC AND TECHNICAL CONCEPTS AND PRINCIPLES**	16.0	100%	11%			
003.	**Define and apply scientific concepts and principles used specifically in transportation systems.**	16.0	100%	11%	C3P	SC	Core
003.01	Define scientific concepts and principles used within transportation systems.	4.0	45%	5%	C1	SC	Core
1	2	3	4	5	6	7	8

TECHNOLOGY EDUCATION
COURSE BLUEPRINT for 8126 (CIP# 21 0101): TRANSPORTATION SYSTEMS
(Course Length: 1 semester; Class Length: 1 period)

003.02	Design, conduct and evaluate lab experiments relating to scientific principles found in transportation systems.	12.0	55%	6%	C3P	SC	Core
C	**HISTORICAL DEVELOPMENTS OF TRANSPORTATION SYSTEMS.**	7.0	100%	6%			
004.	**Analyze important historical developments in transportation systems.**	7.0	100%	6%	CP3	SS/SC	Core
004.01	Organize and explain major developments in the evolution of transportation systems.	2.0	33%	2%	C3	SS/SC	Core
004.02	Design, conduct and evaluate laboratory experiments relating to the evolution of transportation systems.	5.0	67%	4%	C3P	SS/SC	Core
D	**VEHICULAR SYSTEMS AND SUB-SYSTEMS**	50.0	100%	64%			
005.	**Explain the fundamental concepts and principles of Transportation Vehicular Sub-systems.**	15.0	45%	30%	C3	SC	Core
005.01	Explain the fundamental concepts, principles and applications of transportation propulsion systems.	3.0	9%	6%	C3	SC	Core
005.02	Explain the fundamental concepts, principles and application of transportation guidance systems.	3.0	9%	6%	C3	SC	Core
005.03	Explain the fundamental concepts, principles, and application of transportation control systems.	3.0	9%	6%	C3	SC	Core
005.04	Explain the fundamental concepts, principles and application of transportation suspension systems.	3.0	9%	6%	C3	SC	Core
005.05	Explain the fundamental concepts, principles and application of transportation structural systems.	3.0	9%	6%	C3	SC	Core
1	2	3	4	5	6	7	8
006.	**Design, build and evaluate a simple land transportation vehicle model.**	10.0	18%	11%	C3P	SC	Core

TECHNOLOGY EDUCATION
COURSE BLUEPRINT for 8126 (CIP# 21 0101): TRANSPORTATION SYSTEMS
(Course Length: 1 semester; Class Length: 1 period)

006.01	Explain the fundamental concepts and principles used in the design and fabrication of actual and model land transportation vehicles.	2.0	8%	5%	C3	SC	Core
006.02	Design, build and evaluate a simple land transportation vehicle model.	8.0	10%	6%	C3P	SC	Core
007.	**Design, build and evaluate a simple water transportation vehicle model.**	10.0	18%	11%	C3P	SC	Core
007.01	Explain the fundamental concepts and principles used in the design and fabrication of actual and model water transportation vehicles.	2.0	8%	5%	C3	SC	Core
007.02	Design, build and evaluate a simple water transportation vehicle model..	8.0	10%	6%	C3P	SC	Core
008.	**Design, build and evaluate a simple air or space transportation vehicle model.**	15.0	19%	12%	C3P	SS	Core
008.01	Explain the fundamental concepts and principles used in the design and fabrication of actual and model air or space transportation vehicles.	3.0	8%	5%	C3	SS	Core
008.02	Design, build and evaluate a simple air or space transportation vehicle model.	12.0	11%	7%	C3P	SS	Core
E	**Transportation Occupational Opportunities**	3.0	100%	3%			
009.	**Assess personal career goals with respect to transportation occupations.**	3.0	100%	3%	C3	SS	Core
009.01	Identify occupational opportunities and trends within transportation systems.	1.0	33%	1%	C1	SS	Core
009.02	Evaluate personal interests and attributes in relation to transportation occupations.	2.0	67%	2%	C3	SS	Core

Section II

Units of Instruction

Unit A

Introduction

COURSE: Transportation Systems

UNIT: Introduction

COMPETENCY: 001.00: Asses the role and importance of transportation systems to society.

OBJECTIVE: 001.01: Define transportation systems and explain their importance to society.

OUTLINE	RESOURCES
A. Definition: Transportation systems move people and/or products.	R2/3
B. Advantages: Speed, people, product movement General improvement of our lives	R2/31; 35
C. Disadvantages: Pollution, dangerous, energy consumption	R2/31; 35
1. Excess speeds is the primary cause of accidents	CG
2. Internal combustion engines produce carbon monoxide	CG
3. One half of all transportation energy is produced by automobiles	R1/111
4. Transportation consumes the highest amount of controlled energy of the four basic systems	CG
5. Transportation consumes around 15% of averages adults income	CG
6. Air pollution caused by transportation systems may change environment	CG
7. All land transportation systems consume large amounts of land	CG R1/51
8. Transportation systems consume 25% of all energy.	CG
9. Transportation systems produce the most carbon monoxide of all industries.	

SUGGESTED ACTIVITIES:

Produce a pie chart showing energy consumption by mode of transportation, then show ton/mile.

OUTLINE	RESOURCES
D. Importance of transportation: five major reasons	R2/32
1. Economic	
2. Tech. Interdependence	
3. Improve life	
4. Satisfy human needs	
5. Solves problems (sewage)	
6. Strategic Defense	
E. All systems are inter-related. (Communication, Manufacturing, Structural Systems)	R2/32
A system is a combination of parts working together for a common purpose or goal	R1/9

COURSE: **Transportation Systems**

UNIT: **Introduction**

COMPETENCY: **001.00: Asses the role and importance of transportation systems to society.**

OBJECTIVE: **001.02: Identify and define the four major modes of transportation and their intermodal relationship.**

OUTLINE	RESOURCES
A. List and describe five types of transportation; land, water, air, space, and intermodal	R1/7; 9 R2/23; 24
B. Define land transportation	R1/53; 108-121
Definition	
NOTE → three types of land transportation vehicles and the importance of h	R2/24
XAMPLES: Pipelines - most efficient for moving fluids, quiet, and have low theft rate	CG
Car - most flexible	
Order of most efficient (ton per mile) to least-rail, truck, bus, car, plane	CG
Trucks consume more energy than rail, water or pipelines	CG
C. Define water transportation	R1/55; R2/25
1. Definition	
2. List three types of water transportation vehicles and the importance of each	R1/125; 123
a. Hovercrafts ride on a cushion of air	R1/131
b. Water transportation is less expensive than truck or airplanes but is slow and therefore used mostly for freight	CG
D. Define air transportation	R1/55; 37-42 R2/25; 27
1. Definition	
a. Air transportation refers to craft which operates in the earth's atmosphere	R1/142
2. List three types of air transportation vehicles and the importance of each	
a. Vertical take-off by helicopter	

OUTLINE	RESOURCES
b. Lighter-than-air example is a (blimp, dirigible, or balloon)	R2/27
c. Helium is used to float dirigibles	R1/138
d. Dirigibles can lift heaviest loads	R1/137
e. Heavier-than-air example is a (airplane, glider, jet)	R1/137
E. Define space transportation	
1. Definition	R1/56; 149-155
2. List three types of space transportation vehicles and the importance of each	R2/27
3. Space travel for humans is currently limited because of the great time need to travel to planets and stars	CG
F. Intermodal	R1/159
1. Definition a. Intermodal is the use of more than one mode of transportation b. Requires a great deal of planning and coordination	R1/82
2. List three examples of intermodal transportation and the importance of each	
a. TOFC stands for "Truck on Flat Car"	
b. COFC stand for "Container on Flat Car"	R1/161
c. Piggyback "Truck trailers on railroad cars"	R1/161

COURSE: Transportation Systems

UNIT: Introduction

COMPETENCY: 001.00: Assess the role and importance of transportation systems to society.

OBJECTIVE: 001.03: Identify and define the five major transportation vehicular systems.

OUTLINE	RESOURCES
A. Define vehicular propulsion systems Examples: sails, jet engines, electric motors	R1/173; R2/28 R1/165
B. Define vehicular guidance systems Examples: compasses, maps, road signs	
C. Define vehicular control systems Examples: gas pedal, rudders, steering wheels	R1/203; R/29
D. Define vehicular suspension systems Examples: tires, wings, boat hulls	R1/219; R2/29-30
E. Define vehicular structural systems Examples: car frame and body, fuselage, boat hulls	R1/233; R2/30
F. Define and give examples of major related systems	R1/247; R2/30
1. Communication systems	
a. Radio, Radar, and VOR communication systems	
2. Manufacturing and maintenance systems	
a. Make and repair devices used in transportation systems	
3. Structural systems	
a. Roads, bridges, tunnels, sea and air ports, space stations, etc.	
4. Legal and governing systems	

COURSE: Transportation Systems

UNIT: Introduction

COMPETENCY: 002.00: **Participate in a responsible and efficient manner as an individual or group member to plan, organize, and carry out activities and projects.**

OBJECTIVE: 002.01: **Identify and explain management skills and quality tools.**

OUTLINE	RESOURCES
A. List and explain the steps of the IDEAL Problem Solving Method	FR5
1. Identify	FR5/20
2. Define	FR5/24
3. Explore	FR5/27
4. Act	FR5/33
5. Look	FR5/20; 36
B. Use of Parliamentary Procedure	
1. Quorum	CG
2. Robert's Rules of Order	CG
3. Presenting amendments	CG
C. Quality Tools	FR4
1. Force Field Analysis	FR4/298
2. Nominal Group Technique	FR4/299
3. Fishbone Diagram (Cause and Effect)	FR4/276
4. Run Chart	FR4/278
5. Flow Chart	FR4/267
6. Other	FR4/266

COURSE: Transportation Systems

UNIT: Introduction

COMPETENCY: 002.00: **Participate in a responsible and efficient manner as an individual or group member to plan, organize, and carry out activities and projects.**

OBJECTIVE: 002.02: **Apply management skills and quality tools effectively.**

OUTLINE	RESOURCES
Performance:	
See Performance Item 2.02.01 and accompanying directions.	CG

COURSE: Transportation Systems

UNIT: Introduction

COMPETENCY: 002.00: **Participate in a responsible and efficient manner as an individual or group member to plan, organize, and carry out activities and projects.**

OBJECTIVE: 002.03 **Explain classroom and lab safety rules and procedures.**

OUTLINE	RESOURCES
A. Ten safety rules - general and specific	FR3-15-20
1. All tools should be properly stored when not in use	R3/231
2. Ask your teacher when in doubt about the operation of any machinery	FR2/18; R3/232
3. Safety glasses must be worn at all times in the lab and when launching model rockets	FR2/18
4. Leave space for fuel expansion when filling fuel tanks	R3/234
5. When working with machinery and electrical equipment:	
a. Remove all jewelry	R3/231
b. Tie back long hair	R3/231
c. Wear safety glasses (include face shields when grinding)	R3/231
d. Wear snug (not loose) fitting clothes	
6. Batteries should be stored in well ventilated places	R3/235
7. Push a wrench with an opened hand	R3/232
8. Keep rags off of hot engines	R3/233
9. Engine parts should be cleaned with kerosene	R3/233
10. Carbon monoxide poisoning symptoms include headache, nausea, ringing ears, and tiredness	R1/xii

COURSE: Transportation Systems

UNIT: Introduction

COMPETENCY: 002.00: **Participate in a responsible and efficient manner as an individual or group member to plan, organize, and carry out activities and projects.**

OBJECTIVE: 002.04 **Apply classroom and lab safety rules and procedures appropriately.**

OUTLINE	RESOURCES
A. Generals Student Behavioral Standards	R2/xii
1. Safety minded attitude	
2. Respectful of self and others	
3. Cooperative (works well with others)	
B. See Performance Item 002.04.01 and accompanying directions	CG

Unit B

Fundamental Scientific and Technical Concepts and Principles

COURSE: Transportation Systems

UNIT: Fundamental Scientific and Technical Concepts and Principles

COMPETENCY: 003.00: Define and apply scientific concepts and principles used specify in transportation systems.

OBJECTIVE: 003.01: Define scientific concepts and principles used within transportation systems.

	OUTLINE	RESOURCES
A.	Aerodynamics	R1/226
B.	Angle of attack	R2/116
C.	Apogee	R1/151
D.	Buoyancy	R1/127; 227
E.	Ballast (Ships and balloons)	R1/227
F.	Center of buoyancy (The location of the center of the boat's displacement) (See Advanced Transportation Systems)	R8
G.	Centrifugal force	R1/90
H.	Centripetal (A force acting inwards- the force exerted by a string on an object being swung around in a circle)	R1/90
I.	Coefficient of drag	R2/62
J.	Control	R1/203; 217
K.	Coordinates	R1/195
L.	Displacement	R2/401
M.	Draft/Displacement	R1/127; 128
N.	Drag	R1/147; 226
O-1	Draft	R1/128
O-2	Dynamometer	R2/286
P-1	Efficiency = energy out/energy in X 100%	R3/149; R1/49
P-2	Electro-magnetic induction	R1/78
Q-1	Energy (Potential and kinetic)	R1/17
Q-2	Equator	R1/195
R.	Friction	R1/45

	OUTLINE	RESOURCES
S-1	Force	R3/151
S-2	Foot-pounds	R1/19
T-1	Geostationary/Geosynchronous orbit: having an equatorial orbit requiring an angular velocity the same as that of the earth so that the position of a satellite in such an orbit is fixed with respect to the earth	CG
T-2	Gravity	R1/226
U.	Horsepower defined	R2/284
V.	Hydraulic systems	R1/85
W.	Hydrodynamics	R1/125; 134
X.	Knot (equals 1.15 miles per hour)	R2/83
Y.	Latitude	R1/195
Z.	Lift	R1/138; 141
AA	Linear Motion	R3/149
BB	Longitude	R1/195
CC	Magnetism (Like magnetic poles repulse, unlike attract) Magnetic Flux	R1/77; 78; 187; 225
DD	Mechanical advantage (Actual mechanical advantage)	R1/60
EE	Navigation	R1/126; 192; 200
FF	Newton's Laws of Motion	R2/139
GG	Newton (As measurement of force) 1 pound of force = 4.448 newtons A newton is the amount of force required to impact an acceleration of one meter per second to a mass of one kilogram	
HH	Perigee	R1/151
II	Pitch (Movement of an aircraft about its lateral axis. Also the angle of the blade of a propeller)	R2/83 & 404
JJ-1	Pneumatic systems	R1/85
JJ-2	Prime Meridian	R1/195
KK	Power (Power - work/time)	R1/19
LL	Reciprocating motion (Back and forth motion)	R1/90
MM	Roll (Movement of an aircraft about its longitudinal axis. Also the side to side motion on a boat or ship)	R2/83
NN	Rotary motion (Circular motion)	R3/149

	OUTLINE	RESOURCES
OO	Rudder	R1/216
PP	Sails (Mainsails, jibs, and spinnaker)	R2/99
QQ	Sines and Tangents	R4/61
RR	Stall (The point at which the lift become so small that it no longer supports the craft or device)	R2/117
SS	Tacking	FR1/106
TT	Thrust	R1/141; 151; 226 R3/165
UU	Torque Watt Work	R3/165 R1/22 R1/20
VV	Vortex (Vortices)	R2/407
WW	Yaw (Different shades of meaning for ships, planes, and windmills)	R1/216; R2/84; 121; 407

30

COURSE: **Transportation Systems**

UNIT: **Fundamental Scientific and Technical Concepts and Principles**

COMPETENCY: **003.00: Define and apply scientific concepts and principles used specify in transportation systems.**

OBJECTIVE: **003.02: Design, conduct, and evaluate lab experiments relating to scientific principles found in transportation systems.**

OUTLINE	**RESOURCES**

Working individually or as team members have the students conduct the following or comparable experiments.

A. Land transportation experiment

1. Friction

Have the student(s) make two land vehicles that are the same in all aspects except: friction on axles. One set made with no friction reduction methods and the second with friction reduction methods (such as bushings, bearings, and/or lubricants. Test by rolling the two different types down a ramp and record the distances traveled. Have students construct a graph of all vehicles and compare.

2. Magnetism

a. Magnet experiment

b. Compass experiment

B. Water transportation experiment

1. Displacement, draft, and buoyancy

Hull shapes, materials, weight

2. Hydrodynamics

Use a shallow water tank as well as a device to hold different hull cross-sections. Place food coloring at the front of each hull to test for drag, eddies, and current flow.

C. Air transportation experiment

1. Lift:

Construct a device using a triple beam balance scale to hold an airfoil cross section in front of a fan. Measure the lift at different air speeds and test different airfoil shapes.

OUTLINE	RESOURCES
2. Pitch, roll, and yaw	
Construct paper gliders from a stiff paper. Cut elevators, ailerons, and a rudder. Manipulate the control flaps on each glider to demonstrate changes in pitch, roll, and yaw.	
D. Space transportation experiment	
1. Stability (Center of effort and center of gravity):	
Test the stability of model rockets using either a string test, cardboard silhouette, or wind tunnel.	
2. Thrust	
Using a balloon, conduct a thrust experiment	R1/151; R2/139
E. See Performance Test-item 3.02.01 and accompanying directions	CG

Unit C

Historical Developments of Transportation Systems

COURSE: Transportation Systems

UNIT: Historical Developments of Transportation Systems

COMPETENCY: 004.00: Analyze important historical developments in transportation systems.

OBJECTIVE: 004.01: Organize and explain major developments in the evolution of transportation systems.

OUTLINE	RESOURCES
Recognize and explain the importance of the following transportation developments	
Major developments of transportation systems	R1/63;
1. Wheel - On flat terrain wheel is more efficient and faster than sled	R2/34; FR1/144
2. Sails - Lateen sail improved efficiency and freedom of movement	R1/173; R2-301
3. Steam engines - Central importance to industrial revolution and ships and trains	R1/137; R2/27
4. Hot air balloon	R1/138; R2/27
5. First power driven aircraft	R1/139
6. First powered heavier than air flight Wright Brothers 1903	R1/110
7. Ford Model T (Freedom of movement for citizens)	R1/147
8. Rocket	R1/148
9. First satellite - Russian Sputnik 1, 1957	R1/148; FR1/320
10. First human space flight - Russia's Yuri Gagarin, 1961	R1/149; FR1/321
11. First lunar landing - Neil Armstrong & Edwin Aldrin, 1969	FR1/321
12. Dugout canoe - preceded the wheel, horse, and sailing vessels	FR1/10
13. Subways - Development depended on electric propulsion	FR1/178
14. Rail Transport verses horse-drawn vehicle - less expensive, more reliable	FR1/177
15. Unmanned space flight (Mariner & Pioneer) - Allow gathering of information from distances to far for manned flight	FR1/322
16. Modern jet commercial airlines such as the Boeing 747 travel over 300 mph	FR1/317
17. Quadrant - Early sailors used this for determining latitude	FR1/110

OUTLINE	RESOURCES
18. Pack animals can carry more weight than humans (a camel can carry up to 1000 lbs)	FR1/110
19. Compass allowed for maintaining a constant course of travel	FR1/44
20. Steamships were less expensive and more reliably powered than sailing ships	FR1/110
21. Roman roads allowed for increased trade, communications, and movement of troops	FR1/61

Unit D

Vehicular Systems and Sub-Systems

COURSE: Transportation Systems

UNIT: Historical Development of Transportation Systems

COMPETENCY: 004.00: Analyze important historical developments in transportation systems.

OBJECTIVE: 004.02: Design, conduct, and evaluate laboratory experiments relating to the evolution of transportation systems.

OUTLINE	RESOURCES
A. Working as individuals or team members have the students complete the following: 1. Research, design, and build a model of a historical transportation device. 2. Evaluate the social, economic, and environment impacts of the device. 3. Write a technical report reporting on the preceding information. 4. Present the research finding to the class using appropriate presentation media.	
B. See Performance Item 4.02.01 and accompanying instruction	CG

COURSE: Transportation Systems

UNIT: Vehicular Systems and Sub-Systems

COMPETENCY: 005.00: Explain the fundamental concepts and principles of Transportation Vehicular Sub-systems.

OBJECTIVE: 005.01: Explain the fundamental concepts, principles, and applications of transportation propulsion systems.

OUTLINE	RESOURCES
A. Purpose of propulsion systems and devices	R1/173; R2/28
B. Types of propulsion systems and devices and their uses and theories of operation:	
1. Heat engines	R3/150-164
a. General Information	
Heat engines are less than 40% efficient	R3/17
b. External combustion	R3/149
1. Steam engine engines	
a - Steam engine - reciprocating motion	R3/154
b - Steam Turbine - rotary motion (power nuclear subs)	
2. Stirling engine - passes heated gas between two cylinders	R3/154
c. Internal combustion engines	R3/154
1. General information:	R3/154
a - Most transportation devices are powered by internal combustion engines	R3/159
b - Major sources of energy is petroleum	CG
2. Gasoline piston engines	R3/159
a - Pistons produce a reciprocating motion	R3/159
b - Most cars are powered by gasoline piston engines	R3/159
c - Gasoline engines operate on two-stroke or four-stroke cycles	R3/160
d - The four cycles of a four stroke engine are intake, compression, power, and exhaust	R3/160

OUTLINE	RESOURCES
3. Diesel engines	
a - Fuel is ignited in a diesel engine by compression	R3/161
b - One advantage of a diesel engine is its fuel economy and reliability	R3/162
c - Diesels are around 40% efficient	R3/149
d - Most ships and large trucks are powered by diesel	R2/28; R3/161
4. Rotary engines "Wankel"	R3/165
a - Rotary engine output is measured in torque	
5. Jet engines	
a - General information	R3/164
1 - Jet engines produce a linear motion	R3/159
2 - Principle same as balloon	R3/165
3 - Jet engines are open on both ends (intake and exhaust)	R3/165
4 - Action of jet engine is continuous and measured in thrust	R3/165
b - Turbojet	R3/165
c - Ramjet (missiles) (simplest of all reaction engines)	
d - Turbofan (airlines) (Fans provide additional thrust)	R1/182
e - Turboprop (small airplanes) (engine powers compressor and propeller)	R3/167
f - Gas turbines (Exposed to high temperatures) (Used to power ships)	R3/167
6. Rocket Engines	R3/168-169
a - General information	R3/169
The most powerful of the internal combustion engines	
b - Liquid propellent (power can be regulated)	R3/169
c - Solid propellent (power can not be regulated) (no need to pump fuel into combustion chamber)	R3/169

OUTLINE	RESOURCES
2. Electric motors	R3/83; 186
a. Universal	R3/365
b. Induction	R3/365
c. Magnetic Levitation (propulsion and suspension)	R1/187
3. Diesel-electric motors (drive trains)	
a. Modern locomotive use diesel engines to generate power to drive electric motors.	R1/188
4. Sails and Propellers (types of sails and purpose)	R2/98-99; R2/86
a. Sails	
1 - Mainsail - Captures most of the wind	R2/99
2 - Jib - Forward of main sail	R2/99
3 - Spinnaker - Placed opposite or along mainsail	R2/99
4 - Lateen - Improved maneuverability for early sailors	FR1/144
b. Propellers	
1 - Pitch is the angle of the propeller blades	R2/83
2 - Pitch measurement determines the number of inches it will move forward per rotation	R2/83
3 - Lower pitch, greater pulling power, higher pitch less	R2/83
5. Transmission Systems	R1/203-205
a. Clutches - Friction and centrifugal	R1/203
b. Drive shafts - Transfers power from engine to drive wheels	
6. Other	
a. Pumps (types of, hydraulic, gear, centrifugal, and reciprocating)	R1/90
b. Photovoltaic Cells	

COURSE: **Transportation Systems**

UNIT: **Vehicular Systems and Sub-Systems**

COMPETENCY: **005.00: Explain the fundamental concepts and principles of Transportation Vehicular Sub-systems.**

OBJECTIVE: **005.02: Explain the fundamental concepts, principles, and application of transportation guidance systems.**

OUTLINE	RESOURCES
A. Purpose of Guidance (navigation and warning system	R1/191; R2/29
Tell device or operator the direction, speed, location (latitude, longitude, altitude, depth) pressure and/or warn of danger.	
B. Types of Guidance Systems and their uses and theories of operation	
1. Graphic (maps, charts, and marker) Systems	
a. Road signs and signals and navigational markers Purpose: give location, instructions, or warning	
1. Land - road signs, stop lights	R1/191
2. Sea and air - buoys, lighthouses	
b. Maps and charts	R1/192
1. General information	
a - The greater the denominator, the less detail but the greater the land area shown	R1/192
b - There is a total of 360 degrees latitude and longitude	R1/195
2. Types of maps and charts	R1/193-95
a - Road maps	
c - Aeronautical charts	R1/193-195
1 - Show location of radio transmitters	
d - Nautical charts	R1/193-95
1 - Show church steeples, water towers, and other high structures	
e - Globes	
1 - Show large land and water masses	R1/195

OUTLINE	RESOURCES
2. Mechanical and electro-mechanical devices	
a. Location, direction, speed, and time devices	
1. Compasses	R1/196
a - Allow for crossing wide bodies of water for early sailors	
b - Magnetic north differs from true north by up to 1000 miles	R1/196
2. Sextants	R/197
a - Mechanical sextant	
b - Radio sextant (measures radio waves given off by sun to determine location)	
3. Gyrocompasses (can be set to point to true north or maintain fixed point in space)	R1/196
4. Radio (radio transmitters, land-based, government owned)	R1/196
5. Radar (bounces radio waves off of objects to determine distance)	R1/200
6. Speedometers	R1/196
7. Airspeed indicators (works off of a pressure differential)	
8. Logs (activated by water pressure-measures speed in knots)	
9. Sonar (bounces sound waves off of objects to determine distance or depth)	R1/200
10. Clocks and timing devices	
a - Clocks (mechanical and electronic)	
b - Tachometers	
b. Pressure and temperature devices	
1. Pressure sensors	
2. Heat sensors	
c. Integrating devices	R3/108
1. Computers	

OUTLINE	RESOURCES
3. Navigational Processes	
a. Dead reckoning	R1/197
Estimate how far and in what direction the vehicle has gone	
b. Piloting	R1/197
1. Uses reading of visible landmarks with compass and chart	
c. VOR (Very High Frequency Omni-directional Range)	R1/199
d. NAVSAT	R1/200
1. Uses multiple satellites to determine location of vehicle	
e. Omega	R1/199
International system used to aid ships approaching land	

COURSE: Transportation Systems

UNIT: Vehicular Systems and Sub-Systems

COMPETENCY: 005.00: Explain the fundamental concepts and principles of Transportation Vehicular Sub-systems.

OBJECTIVE: 005.03: Explain the fundamental concepts, principles, and application of Transportation Control Systems.

OUTLINE	RESOURCES
A. Purpose of Transportation Control Systems	
1. Control systems are designed to control location, speed and/or vehicle	R1/203
2. Degrees of freedom	R1/203
Train-1; Car-2; helicopter-3	
B. Types of Transportation Control Systems and their uses and theories of operation	R1/203-208
1. Speed control systems and devices	
a. Measurement of speed	
1. Land-kilometers per hour or miles per hour	
2. Water-knots	
3. Air-miles per hour and knots	
b. Acceleration	
1. Increase applied forces	
a - Increase fuel	
b - Increase applied energy (sail opened or turned to capture greater lift or glider pitch to use gravity to increase assent or sub use of air tanks)	
c - Change propeller pitch/speed	
2. Increase mechanical advantage (gear up)	

OUTLINE	RESOURCES

c. Deceleration

1. Decrease applied forces

a - Decrease fuel consumption

b - Decrease applied energy (sail folded or turned to lessen lift, etc.)

c - Change propeller pitch/speed

2. Decrease mechanical advantage (gear down)

3. Braking systems — R1/209

a - Drum

b - Disc

2. Controlling direction

a. Fixed rails and guideways (trains, elevators)

b. Steering systems

1. Wheel and track (bulldozer, tanks) systems (friction systems)

a - Caster — R1/212

b - Camber — R1/212

2. Rudders (boats, ships, and planes) — R2/121
(Includes propellers, rotors, ailerons, and elevators)
(Fluid- aerodynamic/hydrodynamic) (Helicopter cyclical pitch)

3. Change of propulsion direction or application (on or off) — R1/216

a - Propulsion fans (dirigibles)

b - Rockets and jets (change of nozzle direction) (on or off)

4. Hot air balloons — R1/214

a - Heated air less dense, floats in cooler air

OUTLINE	RESOURCES

3. Transmitting Power (Transmission systems)

   a. Clutches - used to engage and disengage power source to wheels, propellers, etc. — R1/203

   b. Drive shafts — R1/203

   c. Transmissions - multiply, divide, or reverse mechanical power

   d. Gearing — R1/206

A power device such as a motor or engine turning a large gear driving a small gear which in turn is driving a wheel or propeller provides greater speed and less torque than a motor or engine turning a small gear driving a large gear turning a driving wheel or propeller. While the later will move more slowly, it will provide greater force (torque)

COURSE: **Transportation Systems**

UNIT: **Vehicular Systems and Sub-Systems**

COMPETENCY: **005.00: Explain the fundamental concepts and principles of Transportation Vehicular Sub-systems.**

OBJECTIVE: **005.04: Explain the fundamental concepts, principles, and application of Transportation Suspension Systems.**

OUTLINE	RESOURCES
A. Purpose of Transportation Suspension Systems	R1/219-232
Suspension systems are designed to support the vehicular system in the environment in which it is designed to operate. This includes enabling it to operate efficiently and to provide comfort and/or freedom from damage to people or things being carried.	
B. Types of Transportation Suspension Systems and their uses and theories of operation	
1. Land	R1/219-232
a. Tires (Pneumatic tires filled with air)	R1/219
Hydroplaneing may cause lose of control	R1/220
b. Springs	
c. Shock absorbers (Reduce spring oscillation)	R1/224
d. Stabilizer bars (Prevents excess leaning going around curves)	R1/224
2. Fluid, water, and air (Aerodynamic/Hydrodynamic)	R1/227
a. Water	R1/228
1. General information	
a - Hull "chine" reduces roll and splashing	
b - Bulkhead isolate sections of ship to reduce likelihood of sinking	
2. Hulls	R1/228
a - Round (Least stable)	R1/228
b - Flat	
c - V-hull	

OUTLINE	RESOURCES
d - Catamaran (One of the most stable)	
e - Tri-hull	
f - Hydrofoils (Rides on "wings" attached to hull)	R1/230
g - Planing hulls (Skim on water at cruising speed)	
h - Displacement hull (Designed to carry great weight)	R1/228
3. Flotation tanks	R1/229
a - Control the buoyancy of submarines	
b. Air	R1/141
1. Wings	
a - All heavier than air vehicles rely on airfoils to provide lift	
2. Envelopes (balloon)	R1/139
a - Blimps rely on helium to provide lift	
b - Hot air balloons rely on hot air to provide lift	
3. Rotor blades	R1/142
a - Helicopters rely on "rotor blades" (Rotating wings) to provide lift	
3. Land and water (air cushioned vehicles)	R1/230
a. Float on cushion of air	
b. Plenum chamber	
c. Annular jet	

COURSE: **Transportation Systems**

UNIT: **Vehicular Systems and Sub-Systems**

COMPETENCY: **005.00: Explain the fundamental concepts and principles of Transportation Vehicular Sub-systems.**

OBJECTIVE: **005.05: Explain the fundamental concepts, principles, and application of Transportation Structural Systems.**

OUTLINE	RESOURCES
A. Definition and Purpose of Transportation Structural Systems	
1. Definition: Parts of vehicles which hold or carry other vehicular systems and the things being carried	
2. Purpose: To provide mounting places for the systems of propulsion, control, suspension and guidance systems and to provide space for the people and/or cargo being transported	
B. Types of Transportation Structural Systems and their uses and theories of operation	R1/233
1. Land	
a. General information	
1. Plastics tend to not be as strong as steel, nor does it withstand the impact of crashes as well	R1/235
2. Larger cars tend to be quieter and safer than smaller cars	R1/234
b. Types of Frames	
1. Chassis "frame"	
2. Uni-body "body-frame combination"	
2. Air	
a. General information (parts of plane's structure: rudder, fuselage, ailerons and their purpose)	R1/140
b. Monocoque (means one shell)	R1/239
1. Provides for more storage space than Truss frame	

OUTLINE	RESOURCES
c. Truss	
d. Non-rigid and semi-rigid (Hot air balloons and blimps)	
e. Hot air balloons (Car (basket) and shroud)	R1/138
3. Water	R1/238
a. Hulls	R1/228
1. General information	
a - Delta shape provides stability and makes it easier to "plane" the boat	R2/82
b - Chine reduces splashing, increases stability	R2/82
c - Displacement hulls carry greater weight	R2/82
d - Bulkheads reduce the possibility of sinking	R1/242
b. Types of hulls	R1/229
1. Round	
2. Flat	
3. V-hull	
4. Catamaran	
5. Tri-hull	
6. Hydrofoil	
c. Flotation tanks - Hull types	
4. Space (Rockets)	
General Information	
a. Single or multiple stages	R1/243
b. Main structural components	
1. Fuselage	
2. Crew compartment (if manned)	
3. Vertical stabilizer	
c. Space shuttle uses ceramic tiles to protect against excessive heat during re-entry	R1/243

COURSE: Transportation Systems

UNIT: Vehicular systems and sub-systems

COMPETENCY: 006.00: Design, build, and evaluate a simple land transportation vehicle model.

OBJECTIVE: 006.01: Explain the fundamental concepts and principles used in the design and fabrication of actual and model land transportation vehicles.

OUTLINE	RESOURCES
A. Propulsion	R1/173-190
General Information	
1. Solar powered vehicles greatly reduce air pollution	
2. Gearing (Increases/decreases speed and torque)	
3. Reduced friction on bearings increases speed	
4. Horsepower =Foot/pound of torque x rpm/5252	R2/288
B. Guidance	R1/191-202
C. Control	R1/203-218
D. Suspension	R1/219-232
General Information	
1. Maglev vehicles ride on magnetic force fields	R2/384
2. Maglev transportation systems have magnets on both the train and the rail system	R2/385
3. Active suspension refers to computerized controlled systems	
E. Structural	R1/233-246
General Information	
1. Small fins placed on the body of a car can reduce air turbulence	
2. Coefficient of drag (the lower the better)	R2/381
3. Vehicles wind resistance (drag) may be tested in a wind tunnel	R2/381
4. Lighter materials, computers, and vortex generators increase fuel efficiency	

COURSE: Transportation Systems

UNIT: Vehicular systems and sub-systems

COMPETENCY: 006.00: Design, build, and evaluate a simple land transportation vehicle model.

OBJECTIVE: 006.02: Design, build, and evaluate a simple land transportation vehicle model.

OUTLINE	RESOURCES
PERFORMANCE:	
See Performance Item 006.02.01 for designing, building and evaluating a simple land transportation vehicle	CG

COURSE: Transportation Systems

UNIT: Vehicular systems and sub-systems

COMPETENCY: 007.00: Design, build, and evaluate a simple water transportation vehicle model

OBJECTIVE: 007.01: Explain the fundamental concepts and principles used in the design and fabrication of actual and model water transportation vehicles.

OUTLINE	RESOURCES
A. Propulsion	
1. Pitch (Of propeller blade) The angle of the blades measured by the distance a propeller moves forward for each revolution (assuming no slippage)	R2/83
2. Sails	R2/99
a) Similar to wings of airplane (Both are airfoils)	
b) High pressure on windward side of sail	R2/99
B. Guidance	
C. Control	
D. Suspension	
E. Structural	
1. Chines (Reduce splashing and rolling of boat or ship)	R2/82
2. Hydrofoils offer much less drag than conventional hulls	R1/130
3. Generally, the greater a boat's draft, the more drag (Slower it goes)	R1/127
4. The greater "surface to water area" a hull has, the greater the drag	CR
5. Deep hull have greater stability	R1/230
6. Displacement (measured in cubic feet or weight of water displaced)	R1/127
a. The greater the displacement, the more it can carry	
7. Double hulls lessen the likelihood of sinking	R1/242
8. Pointed bows offer less resistance than rounded or squared bows	CR
9. Wide, flat hulls are designed to carry heavy loads	R1/128

COURSE: Transportation Systems

UNIT: Vehicular systems and sub-systems

COMPETENCY: 007.00: Design, build, and evaluate a simple water transportation vehicle model

OBJECTIVE: 007.02: Design, build, and evaluate a simple water transportation vehicle model.

OUTLINE	RESOURCES
PERFORMANCE	
See Performance Item 007.02.01 and accompanying directions for the designing, building and evaluating of a simple water transportation vehicle	CG

COURSE: **Transportation Systems**

UNIT: **Vehicular systems and sub-systems**

COMPETENCY: **008.00: Design, build, and evaluate a simple sir or space transportation vehicle model.**

OBJECTIVE: **008.01: Explain the fundamental concepts and principles used in the design and fabrication of actual and model air and space transportation vehicles.**

OUTLINE	RESOURCES
A. Propulsion	
1. Converting pounds of thrust to newtons 1 pound = 4.48 newtons	R2/396
2. Wind propels hot air balloons	R1/137
3. Gliders propelled by wind currents	CG
4. Model rockets use solid fuel engines	R1/184
B. Guidance	
C. Control	
D. Suspension	
1. Airfoils (Wings)	
a. Chamber (upper and lower part of wing)	R2/116
b. Excessive turbulence on top of an airfoil can call stall	R2/117
c. Aspect ration (Span/cord)	R2/118
1. The higher the ratio the greater the wing's efficiency	R2/118
d. Winglets can reduce wing vortices	R2/118
e. Wing types and characteristics	
1. Straight - Excellent stall characteristics and economical to build	R2/118
2. Tapered	R2/118
3. Elliptical - Most efficient	R2/118
4. Sweptback and delta (Jet fighters)	R2/118
2. Balloons	R1/138
Supported by hot air (float in a sea of air)	

OUTLINE	RESOURCES
E. Structural	R1/233-246

COURSE: Transportation Systems

UNIT: Vehicular systems and sub-systems

COMPETENCY: 008.00: Design, build, and evaluate a simple sir or space transportation vehicle model.

OBJECTIVE: 008.02: Design, build, and evaluate a simple air or space transportation vehicle model.

OUTLINE	RESOURCES
PERFORMANCE	
See Performance Item 008.02.01 and accompanying directions for designing, building, and evaluating a simple air/space vehicle.	CG

Unit E

Transportation
Occupational Opportunities

COURSE: Transportation Systems

UNIT: Transportation Occupational Opportunities

COMPETENCY: 009.00: Assess personal career goals with respect to transportation occupations.

OBJECTIVE: 009.01: Identify occupational opportunities and trends within transportation systems.

OUTLINE	RESOURCES
A. General	CG
1. Occupational Outlook Handbook (Excellent source of information pertaining to occupations)	
2. Aptitude refers to how quickly one is able to learn a skill and grasp its concepts	
B. Land transportation occupations	CG
1. Changes in the economy generally have small effect upon mechanics	
2. Automotive mechanics need good analytical, communication, mathematical, and scientific skills	
C. Water transportation occupations	CG
D. Air transportation occupations	CG
1. Ground controllers direct planes on the ground and preparing for take-off	
2. Control of aircraft in the air is directed by air traffic controllers	
3. Aerospace engineers help design, develop, build, and test military and commercial aircraft	
4. Generally, air traffic controllers are not likely to be unemployed	
5. Aircraft mechanics can expect excellent job opportunities in the future	
E. Space transportation occupations	CG

COURSE: Transportation Systems

UNIT: Transportation Occupational Opportunities

COMPETENCY: 009.00: Assess personal career goals with respect to transportation occupations.

OBJECTIVE: 009.02: Evaluate personal interests and attributes in relation to transportation occupations.

OUTLINE	RESOURCES
A. Review and update his/her CDP (Career Development Plan) with respect to transportation occupational skills.	CG
B. Research a transportation occupation of interest. Write and deliver a report to the class.	CG
C. See Performance Item 009.02.01 for detail instructions	CG

Section III

Appendices

Appendix A

Bibliography/References

Appendix A
Bibliography

REFERENCES:

R-1a* Johnson, S., Farrar-Hunter, P. Exploring Transportation. South Holland Ill: Goodheart-Willcox, 1993.
R-1b Instructors Manual-Exploring Transportation
R-1c Student Activity Manual-Exploring Transportation
R-2a Schwaller, A.E. Transportation, Energy and Power Technology. Albany, NY: Delmar, 1989.
R-2b Instructors Guide-Transportation, Energy and Power Technology
R-3a Bohn, C.B and MacDonald, A.J. Energy Technology, Power and Transportation. Peoria, Ill.:Glencoe, 1992.
R-3b Instructor's Resource Guide-Energy Technology, Power and Transportation
R-3c Student Workbook-Energy Technology, Power and Transportation
R-4 Pratt, Douglas R. Basics of Model Rocketry, Waukesha, Wi.: Kalmback Books, 1993.

FR-1** Williams, Trevor I. History of Invention. New York, N.Y.:Facts On File Publications, 1987.
FR-2 DeLuca, W. and Haynie, J. Safety System Design for Technology Education. Raleigh, N.C.: NCDPI, 1990.
FR-3 1994-96 Curricular Resources Guide. Reston, Va.:Technology Student Association, 1994.
FR-4 Brassard, M. Memory Jogger Plus +. Methuen, Ma.: Goal/QPC, 1989.

SR-1*** Schmidt, Norman Discover Aerodynamics with Paper Airplanes Winnipeg, Canada: Peguis Publishers Limited, 1991.
SR-2 Eden, Maxwell Kiteworks: Explorations in Kite Building and Flying New York, N.Y.: Sterling Pub. Co. Inc., 1991.

R* Primary References-All test-item questions are taken from primary references or former references. Each test-item gives the specific reference text and page used for writing the item. Within the Transportation Test-item Bank under the "attribute"section of each test-item, will be found the exact text and page number of the information used to write the test-item.

FR** Former References-These are media used in a previous course(s).

SR*** Secondary References-These are materials which provides additional and/or in depth information regarding the content in question. While no test-items are derived from this material it is never-the-less strongly recommended that this media be purchased to provide both the teacher and the student additional resource information.

Appendix B

Vendor's Addresses for Texts, Literature, Films, and Software

Technology Education
Vendor's Addresses for Texts, Literature, Film, and Software
Addendum, July 26, 1995

To request taping of the Exploring Technology Education tapes contact your Regional TAC or NC Dept. of Public Instruction Division of Media and Technology.

AAAS Books
Dept. 2061, P.O. Box 753
Walddorf, Md. 20604
(301) 645-5643

Agency for Instructional Technology
Box A
Bloomington, Indiana 47402
(800) 457-4509

Career Publishing, Inc.
910 N. Main Street
Orange. CA 92613
(800) 854-4014

Creative Learning Systems
16510 Via Esprillo
San Diego, Ca. 92127
(800) 458-2880

Delmar Publishing Inc.
Computer Drive West
Albany, N.Y. 12212
(800) 347-7707
Rep. Patrick Delaney
704-567-8911

Glencoe/McGraw Hill
3305 Donner Trail
Wake Forest, N.C. 27587
Rep. Laurie Merlo
(919) 556-8453

Goal/QPC
13 Branch Street
Methuen, Ma. 01844-1953
(800) 643-4316

Goodheart-Willcox Co., Inc.
123 West Taft Drive
South Holland, Ill. 60473
1-800-323-0440
Rep. Gwen Willis
(704) 333-9247

Harcourt, Brace, Jovanovich, Pub.
2602 Kings Mill Rd.
Greensboro, N.C. 27407
Rep. Frank Wypasck
(919) 299-5489

Mid-America Vocational Curriculum Consortium
1500 West Seventh Avenue
Stillwater, Oklahoma 74074
(800) 654-3988

NC Dept. of Public Instruction
Division of Media and Technology
Education Building
301 North Wilmington Street
Raleigh, N.C. 27601-1714
919-715-1706

Oxford University Press
2001 Evans Road
Cary, N.C. 27513
(919) 677-0977

Pitsco
1004 East Adams
P.O. Box 1328
Pittsburg, Ks. 66762
(800) 835-0686

Regents/Prentice Hall
416 Bay Run
Newport, N.C. 28570
Rep. Sandra Ivey
(919) 247-2647

San Diego Technical Books, Inc.
4698 Convoy Street
San Diego, Ca. 92111
Rep. Amy
(800) 346-0071

Small World Technologies
P.O. Box 607
Hillsboro, Oregon, 97123
Rep. Gene Small
(800) 542-3555 or (503) 640-1729

TSA (Technology Student Association)
1914 Association Drive
Reston, Va. 22091
(703) 860-9000

West Educational Publishing
620 Opperman Drive
P.O. 64779
St. Paul, Mn. 55164-0779
Rep. Carl Holm (301) 916-9817

Appendix C

Equipment List

Transportation Systems
Equipment List

EQUIPMENT	QUANTITY
Wind-tunnel	1
CO_2 Vehicle Start and Finish Gate	1
CO_2 Track Software	1
Model Steam Engine	1
Model Stirling Engine	1
Maglev Vehicle Rail Systems and Controls	1
Vane Anemometer/Thermometer	1
Hot Air Balloon Launcher (Propane)	1
Model Rocket Fin Aligner	12
Model Rocket Digital Launcher	1
Model Rock Launch Pad	1
Model Rocket Locator	1
Gyroscope	1
Testing-tank (For water transportation)	1

Appendix D

Software and Video

Transportation Systems
Software and Video

Software/Video	Quantity
Engineering Technology: Principles of Flight Video Part 1 (Or comparable)	1
Engineering Technology: Principles of Flight Video Part 2 (Or comparable)	1
Engineering Technology: Weight and Balance of an Aircraft Video (Or comparable)	1
Flight Simulator Software	2

Appendix E

VoCATS
Transportation Systems Test-item Bank

DIRECTIONS FOR MULTIPLE-CHOICE ITEMS: Read each of the following multiple-choice items and the possible answers carefully. Mark the letter of the correct answer on your answer sheet or as instructed by your teacher. **REMEMBER: MAKE NO MARKS ON THIS TEST.**

1 Transportation consumes:
A. 50% of the typical American's freetime.
B. Less energy than the residential sector.
C. 5% of all the energy consumed in the United States.
D. 25% of all the energy consumed in the United States.

2 The cost of transportation makes a large economic impact on people's lives. What percentage of personal income do average American adults spend on transportation?
A. 9%
B. 15%
C. 28%
D. 42%

3 All land transportation systems (highway, rail, and pipeline) share one major enviromental and economic impact:
A. Very high air pollution.
B. High rates of fatal accidents.
C. The consumption of large amounts of land.
D. Noise pollution.

4 Technology used to move people and products is one definition of:
A. Communication.
B. Manufacturing.
C. Structural Systems.
D. Transportation.

5 Out of all the energy used in transportation systems, over half is used by:
A. Railroads.
B. Airplanes.
C. Automobiles.
D. Pipelines.

6 Which of the following have caused the greatest increase in automobile accidents?
A. Foreign imports
B. Travel speeds
C. Vehicle systems failures
D. Poorly maintained roads

7 Transportation systems produce more of this than any other industry:
A. Methane gas.
B. Carbon dioxide.
C. Carbon monoxide.
D. Ozone.

GO TO NEXT PAGE

8 Generally, North Carolina's transportation systems:
A. Improve our quality of life.
B. Make people poorer.
C. Have little affect upon the environment.
D. Are a very small portion of the state budget.

9 An efficient transportation system contributes to which of the following?
A. Social needs
B. Economic needs
C. Strategic defense
D. All of the above

10 A combination of parts or subsystems working to-gether for a common purpose defines:
A. Transportation.
B. System.
C. Process.
D. Knowledge.

11 Anticipating the results of a new transportation technology allows us to:
A. Control or eliminate all negative effects.
B. Eliminate all change that might have a negative impact.
C. Make responsible decisions about the use of the new technology.
D. Foresee all impacts of the new technology.

12 In intermodal transportation, carrying truck trailers on railroad flatcars is called:
A. Containerization.
B. Piggyback.
C. Hauling.
D. Container ship.

13 A water vessel that rides on a cushion of air is a:
A. Hydrofoil.
B. Hovercraft.
C. Jet ski
D. Gunwale.

14 Freight, transported to a harbor by rail, is taken by boat to another destination. This product movement is an example of:
A. Interim transportation.
B. Multi-method transportation.
C. Intermodal transportation.
D. Intracoastal transportation.

15 At the present usage rates, which of the following methods of transporting freight consumes as much energy as all of the other three combined?
A. Pipeline
B. Railroad
C. Waterway
D. Truck

GO TO NEXT PAGE

16 Using more than one form of transportation to move freight or products is called:
A. Interstitial transportation.
B. Interurban transportation.
C. Interim transportation.
D. Intermodal transportation.

17 In intermodal transportation COFC stands for:
A. Container on Flat Car.
B. Conveyor onto Freight Carrier.
C. Crane onto Flat Car.
D. Cargo on Freight Carrier.

18 In air transporation, an example of a vertical take-off vehicle is a:
A. Helicopter.
B. Rocket.
C. Glider.
D. Piper Cub.

19 A dirigible is a rigid lighter-than-air ship kept afloat by:
A. Hot air.
B. Propane.
C. Nitrogen.
D. Helium.

20 Low noise output, low theft rate, and no traffic congestion are special advantages of:
A. Highway trucking systems.
B. Pipeline systems.
C. Railroad systems.
D. Intercoastal waterways.

21 Using more than one form of transportation mode to move freight or products is called:
A. Intermodal shipping.
B. Intracoastal shipping.
C. Intercoastal shipping.
D. International shipping.

22 The type of transportation that operates in the earth's atmosphere is:
A. Air transportation.
B. Space transportation.
C. Suspension transportation.
D. Take-off transportation.

23 Because of its cost effectiveness and relative slowness, most water transportation business involves the movement of:
A. People.
B. Coal.
C. Cargo.
D. None of the above.

GO TO NEXT PAGE

24 An example of a heavier-than-air craft is a:
A. Glider.
B. Balloon.
C. Dirigible.
D. Blimp.

25 The aircraft which can lift and transport the heaviest loads is a:
A. Dirigible.
B. Helicopter.
C. Hovercraft.
D. Commercial plane.

26 When compared to commuter trains, the private automobile has the following advantage:
A. Reduced pollution.
B. Reduced traffic congestion.
C. Increased flexibility.
D. Reduced accidents.

27 Which of the following is a disadvantage of shipping cargo by water?
A. Slow travel
B. Limited access to much of the world
C. Subject to weather conditions
D. All of the above

28 Which of the following is an advantage of shipping cargo by water?
A. Relatively low cost
B. Ability to move large volumes and bulky materials
C. Movement between continents
D. All of the above

29 Ability to carry large and heavy loads at a low cost per mile and low pollution are special advantages of:
A. Highway trucking systems.
B. Railroad systems.
C. Air freight systems.
D. Hovercraft.

30 Cargo, lifted onto a flat car by a crane, is transported by rail to another destination. This product movement is an example of:
A. Interim transportation.
B. Intercoastal transportation.
C. Intermodal transportation.
D. Intracoastal transportation.

31 One mode of lighter-than-air transportation is:
A. Hydrofoils.
B. Hovercrafts.
C. Airfoils.
D. Dirigible.

GO TO NEXT PAGE

32 You are in charge of creating a transportation system for moving water from a lake to the city. Which of the following would probably be the most efficient means of moving the water?
A. Truck
B. Train
C. Buses
D. Pipeline

33 In intermodal transportation TOFC stands for:
A. Truck on Freight Carrier.
B. Tugboat onto Flat Car.
C. Trailer on Flat Car.
D. Tramp onto Freight Carrier.

34 Intermodal transportation requires a significant amount of:
A. Time and money.
B. Planning and coordination.
C. Goods and services.
D. Advertising.

35 Of the following, which is the most important current limitation preventing travel to other planets?
A. The time it would take to get there
B. Communication over such great distances
C. The great amounts of power needed after leaving Earth's gravity
D. Navigation, it would be very hard to keep from getting lost in space

36 You have a very large cargo to transport from Raleigh, NC to Atlanta, GA. Which of the following modes of transportation will be the most efficient?
A. Car
B. Bus
C. Airplane
D. Railroad

37 Sails, jet engines, and electric motors are examples of:
A. Propulsion systems.
B. Guidance systems.
C. Control systems.
D. Suspension systems.

38 The parts of a vehicle that hold the things to be carried and the rest of the vehicle's systems are called its:
A. Suspension system.
B. Control system.
C. Structural system.
D. Storage system.

39 The parts of a vehicle that support the vehicle in its environment (such as the wings on an airplane) are called:
A. Control system.
B. Suspension system.
C. Guidance system.
D. Conversion system.

GO TO NEXT PAGE

40 Stabilizer bars, springs, and tires are all parts of a car's:
A. Control system.
B. Guidance system.
C. Suspension system.
D. Conversion system.

41 The parts of a vehicle that are used to change a vehicle's direction and speed are part of the vehicle's:
A. Propulsion system.
B. Suspension system.
C. Guidance system.
D. Control system.

42 The system of a vehicle, that converts energy to produce power, that moves the vehicle is called its:
A. Control system.
B. Suspension system.
C. Conversion system.
D. Propulsion system.

43 No transportation vehicle could move without a source of:
A. Compression.
B. Combustion.
C. Traction.
D. Propulsion.

44 A car's body is an example of a:
A. Suspension system.
B. Control system.
C. Storage system.
D. Structural system.

45 Engines, magnetic levitation and nuclear energy are used in which system?
A. Propulsion system
B. Combustion system
C. Exhaustion system
D. Conversion system

46 Information required by a vehicle to follow a particular path or to perform a certain task is provided by a(n):
A. Coordinate.
B. Operator manual.
C. Guidance system.
D. Control system.

47 While riding her bicycle to the store, Gina sees a sign indicating road construction ahead. The sign is an example of which system?
A. Propulsion system
B. Suspension system
C. Guidance system
D. Control system

STOP HERE

Test Name: TRNSYC01
Scan Form: GPFORMS
Test Label:

Subtest Name	Number of Items	Number of Objectives	Starting Item Number
TRANS SYS COMPETENCY ONE	47	3	1

Answer Key for TRANS SYS COMPETENCY ONE

1)D	2)B	3)C	4)D	5)C	6)B	7)C	8)B
9)D	10)B	11)C	12)B	13)B	14)C	15)D	16)D
17)A	18)A	19)D	20)B	21)A	22)A	23)C	24)A
25)A	26)C	27)D	28)D	29)B	30)C	31)D	32)D
33)C	34)B	35)A	36)D	37)A	38)C	39)B	40)C
41)D	42)D	43)D	44)D	45)A	46)C	47)C	

Item Codes for TRANS SYS COMPETENCY ONE

1)001.01.04	2)001.01.05	3)001.01.06	4)001.01.02
5)001.01.01	6)001.01.07	7)001.01.03	8)001.01.08
9)001.01.09	10)001.01.10	11)001.01.11	12)001.02.17
13)001.02.02	14)001.02.01	15)001.02.11	16)001.02.24
17)001.02.15	18)001.02.23	19)001.02.22	20)001.02.08
21)001.02.16	22)001.02.19	23)001.02.12	24)001.02.21
25)001.02.03	26)001.02.10	27)001.02.14	28)001.02.13
29)001.02.07	30)001.02.18	31)001.02.20	32)001.02.05
33)001.02.25	34)001.02.06	35)001.02.09	36)001.02.04
37)001.03.01	38)001.03.02	39)001.03.06	40)001.03.07
41)001.03.04	42)001.03.08	43)001.03.03	44)001.03.05
45)001.03.09	46)001.03.10	47)001.03.11	

Objective Labels for TRANS SYS COMPETENCY ONE

1)1.01A EXP TRAN SYS IMPORTANCE
2)1.02A IDENT/DEF MODES OF TRANS
3)1.03A IDENT/DEF VEHICULAR SYS

Objective Codes for TRANS SYS COMPETENCY ONE

1)001.01	for 1.01A EXP TRAN SYS IMPORTANCE
2)001.02A	for 1.02A IDENT/DEF MODES OF TRANS
3)001.03A	for 1.03A IDENT/DEF VEHICULAR SYS

Number of Items Measuring each TRANS SYS COMPETENCY ONE Objective

1) 11 in 1.01A EXP TRAN SYS IMPORTANCE
2) 25 in 1.02A IDENT/DEF MODES OF TR
3) 11 in 1.03A IDENT/DEF VEHICULAR SYS

Test Name: TRNSYC01
Scan Form: GPFORMS
Test Label:

Items Measuring TRANS SYS COMPETENCY ONE 1.01A EXP TRAN SYS IMPORTANCE

1) 1	2) 2	3) 3	4) 4	5) 5	6) 6	7) 7	8) 8
9) 9	10) 10	11) 11					

Items Measuring TRANS SYS COMPETENCY ONE 1.02A IDENT/DEF MODES OF TRANS

1) 12	2) 13	3) 14	4) 15	5) 16	6) 17	7) 18	8) 19
9) 20	10) 21	11) 22	12) 23	13) 24	14) 25	15) 26	16) 27
17) 28	18) 29	19) 30	20) 31	21) 32	22) 33	23) 34	24) 35
25) 36							

Items Measuring TRANS SYS COMPETENCY ONE 1.03A IDENT/DEF VEHICULAR SYS

1) 37	2) 38	3) 39	4) 40	5) 41	6) 42	7) 43	8) 44
9) 45	10) 46	11) 47					

Mastery Level for TRANS SYS COMPETENCY ONE Objectives

1) 8 out of 11 for 1.01A EXP TRAN SYS IMPORTANCE
2) 19 out of 25 for 1.02A IDENT/DEF MODES OF TRANS
3) 8 out of 11 for 1.03A IDENT/DEF VEHICULAR SYS

Partial Level for TRANS SYS COMPETENCY ONE Objectives

1) 7 out of 11 for 1.01A EXP TRAN SYS IMPORTANCE
2) 15 out of 25 for 1.02A IDENT/DEF MODES OF TRANS
3) 7 out of 11 for 1.03A IDENT/DEF VEHICULAR SYS

DIRECTIONS FOR MULTIPLE-CHOICE ITEMS: Read each of the following multiple-choice items and the possible answers carefully. Mark the letter of the correct answer on your answer sheet or as instructed by your teacher. **REMEMBER: MAKE NO MARKS ON THIS TEST.**

1 The reference source for the operational procedures of most organizations is:
A. Lovejoy's Guide.
B. Robert's Rules of Order.
C. Webster's Business Guide.
D. Roget's Parliamentary Rules and Procedures.

2 The number of members that must be present for business to be conducted is called a:
A. Voting block.
B. Parliament.
C. Quorum.
D. Committee.

3 The quality tool used to determine the "Driving Forces" and "Restraining Forces" for a problem or issue is the:
A. Cause and Effect Diagram Method.
B. Force Field Analysis Method.
C. Nominal Group Technique.
D. Run Chart.

4 What is the fifth step of the IDEAL Problem Solving Method?
A. Learn perceptual patterns
B. Listen to other people's ideas
C. Look back and learn from the effects of your activities
D. List all possible solutions to the problem

5 The quality tool which is designed to give everyone in the group an equal voice is the:
A. Cause and Effect Process.
B. Force Field Analysis Method.
C. Nominal Group Technique.
D. Equal Interaction Method.

6 What is the second component of the IDEAL approach to problem solving?
A. Dealing with the problem
B. Defining the problem
C. Determining solutions to existing problems
D. Describing possible strategies

7 The first component in the IDEAL approach to problem solving is:
A. Identifying the problem.
B. Inventing solutions to existing problems.
C. Illustrating potential solutions to problems.
D. Itemizing potential problem areas.

GO TO NEXT PAGE

8 What is the fifth step of the IDEAL approach to problem solving?
A. Learn some perceptual patterns
B. Listen to other people's ideas
C. Look back and evaluate the effects of your activities
D. List all possible solutions to the problem

9 A motion can be changed by a motion to:
A. Table.
B. Resign.
C. Rescind.
D. Amend.

10 What is the fourth component of the IDEAL approach to problem solving?
A. Approaching the problem
B. Activating concepts
C. Acting upon strategies
D. Analyzing the problem

11 What is the third component of the IDEAL approach to problem solving?
A. Exploring alternative approaches to the problem
B. External representation of the problem
C. Explaining details of the problem
D. Extracting data concerning the problem

12 When finished working with sharp-pointed or sharp-edged tools put them:
A. In any available drawer.
B. On the edge of your work table.
C. On the floor next to your feet.
D. In their proper storage area.

13 Before using tools or machines which can cause injury you should always:
A. Review the appropriate safety manual.
B. Ask a friend for help.
C. Ask your teacher for permission.
D. Check the condition of all circuit-breakers connected to the equipment.

14 Safety glasses must be worn:
A. Only when operating a machine.
B. Only when one is producing dust or metal particles.
C. Only when grinding metals.
D. Whenever one is in the technology lab.

15 Which of the following is the most important safety consideration to observe while launching model rockets?
A. The launch team should wear leather gloves
B. Everyone should wear safety glasses
C. The launch pad must be made of asbestos
D. There must be at least an 8-mile-per-hour wind to prevent rockets from landing on the observation team

GO TO NEXT PAGE

16 When refueling a fuel tank it should:
A. Be filled to the very top.
B. Have space left for fuel expansion.
C. Never be touched on the spout.
D. Be filled quickly.

17 In a technology laboratory, slipping tools can cause injury and:
A. Ruin a nut or bolt.
B. Loosen stuck bolts easily.
C. Prevent hand injuries.
D. Reduce working time.

18 If you are not sure how to use a laboratory machine you should:
A. Ask your teacher for help.
B. Experiment with the machine by yourself until it works.
C. Take the machine apart to see how it works.
D. Ask someone else to work the machine for you.

19 When working around machinery or electrical equipment one must:
A. Remove all jewelry.
B. Tie back long hair.
C. Wear safety glasses.
D. Do all the above.

20 Charged batteries should be kept:
A. In well ventilated areas.
B. In sealed containers.
C. Near a heat source.
D. Near welding stations.

21 When loosening a stuck bolt or nut, you should push the wrench with:
A. All fingers wrapped tightly around the handle.
B. A slightly larger wrench.
C. An open hand.
D. A hammer, screwdriver, or lever.

22 A hot engine should:
A. Only be touched safely on the cylinders.
B. Not be covered with rags.
C. Only be touched safely on the exhaust system.
D. Be covered with plastic sheets.

23 When operating equipment with rotating parts, long hair and loose clothing should be:
A. Removed.
B. Tied back or covered.
C. Uncovered and hanging freely.
D. Pushed loosely out of the operator's way.

GO TO NEXT PAGE

24 In a technology lab, when should both safety glasses AND face shields be worn?
A. When performing any type of lab work
B. When working with motors or engines
C. When working with sharp-pointed or sharp-edged tools
D. When working with grinders

25 Engine parts should be cleaned with:
A. Gasoline.
B. Kerosene.
C. Neoprene.
D. Ethylene.

26 A headache, nausea, ringing in the ears, and tiredness are symptoms of:
A. Carbon monoxide poisoning.
B. Food poisoning.
C. Electrical shock.
D. None of the above.

DIRECTIONS FOR PERFORMANCE ITEMS See your teacher or test administrator for instructions on completing the following performance item(s).

27 As a member of a team complete the following:

1) Effectively participate as a member of a team.
2) Appropriately and effectively use one or more of the following "quality" tools: Fishbone Diagram, Force Field Analysis, Nominal Group Technique, and Run Chart.
3) Correctly use supporting graphics for the above tools.

Your work will be assessed using the following criteria:

	Scoring
Participate effectively as a team member by demonstrating appropriate behavior, being considerate of others, communicating well, demonstrating leadership skills, and keeping a customer focus when appropriate.	0-40 points
Effectively use one or more quality tools	0-30 points
Effectively use appropriate graphics Clearly communicated essential information	0-30 points
Total Score Possible	0-100 points

GO TO NEXT PAGE

28 Demonstrate a safety conscious attitude in the technology classroom and lab. This includes the proper use of hand tools and equipment. Your teacher will provide you will a more detail explanation of what is expected. You will be assessed using the following criteria:

	Scoring
Demonstrates a safety conscience attitude and behaves in a safe manner	0-50 points
Demonstrates proper use of handtools and equipment	0-50 points
Total Possible Score	0-100 points

STOP HERE

Directions for Item 27

During this course, have each student use one or more quality tools (Fishbone Diagram, Force Field Analysis, Nominal Group Technique, or other appropriate tool) to analyze data or to solve a problem. Stress the utility and power of the various tools in solving problems.

Directions for Item 28

The students are expected to behave in a safe manner at all times, in the classroom as well as the laboratory. They are also expected to use all tools (simple and complex) appropriately.

GO TO NEXT PAGE

Scoring Directions for Test Item 27 Unit 1 Key 27

Each student is expected to effectively participate as a team member and apply the listed "quality " tools appropriately. Working to solve a specific problem and as a team member each student must use one or more of the following tools:

Fishbone Diagram
Force Field Analysis
Nominal Group Technique
Rune Chart

Observe the interaction of the team and assess each student using the following criteria:

	Scoring
Participated effectively as a team member by demonstrating appropriate behavior, was considerate of others, communicated well, demonstrated leadership skills, and kept a customer focus when appropriate	0-40 points
Efffectively used one or more of the above tools	0-30 points
Effectively used appropriate graphics with quality tools which clearly communicated essential information	0-30 points
Total Possible Score	100

Scoring Directions for Test Item 28 Unit 1 Key 28

Assess each student for proper safety procedures, attitude, and proper tool and equipment usage. Give the students a detailed explanation of the correct behaviors and procedures and your expectations of them. Assess each student using the following criteria:

	Scoring
Demonstrates safe behavior and attitude in classroom and laboratory	0-50 points
Uses tools and equipment appropriately	0-50 points
Total Possible Score	0-100 points

GO TO NEXT PAGE

Test Name: TRNSYC02
Scan Form: GPFORMS
Test Label:

Subtest Name	Number of Items	Number of Objectives	Starting Item Number
TRANS SYS COMPETENCY TWO	28	5	1

Answer Key for TRANS SYS COMPETENCY TWO

1)B	2)C	3)B	4)C	5)C	6)B	7)A	8)C
9)D	10)C	11)A	12)D	13)C	14)D	15)B	16)B
17)A	18)A	19)D	20)A	21)C	22)B	23)B	24)D
25)B	26)A	27)S	28)S				

Item Codes for TRANS SYS COMPETENCY TWO

1)002.01.02	2)002.01.01	3)002.01.04	4)002.01.03
5)002.01.05	6)002.01.08	7)002.01.07	8)002.01.11
9)002.01.06	10)002.01.10	11)002.01.09	12)002.03.08
13)002.03.02	14)002.03.03	15)002.03.06	16)002.03.11
17)002.03.14	18)002.03.12	19)002.03.04	20)002.03.09
21)002.03.13	22)002.03.10	23)002.03.07	24)002.03.01
25)002.03.15	26)002.03.05	27)002.02.01	28)002.04.01

Objective Labels for TRANS SYS COMPETENCY TWO

1)2.01A EXP MANAGEMENT SKILLS	2)1.01A EXP TRAN SYS IMPORTANCE
3)2.03A EXP SAFETY PROCEDURES	4)APPLY MANAGEMENT SKILLS
5)APPLY SAFETY PROCEDURES	

Objective Codes for TRANS SYS COMPETENCY TWO

1)002.01A	for 2.01A EXP MANAGEMENT SKILLS
2)001.01	for 1.01A EXP TRAN SYS IMPORTANCE
3)002.03A	for 2.03A EXP SAFETY PROCEDURES
4)002.02	for APPLY MANAGEMENT SKILLS
5)002.04	for APPLY SAFETY PROCEDURES

Number of Items Measuring each TRANS SYS COMPETENCY TWO Objective

1) 10 in 2.01A EXP MANAGEMENT SKILLS	2) 1 in 1.01A EXP TRAN SYS IMPORTAN
3) 15 in 2.03A EXP SAFETY PROCEDURES	4) 1 in APPLY MANAGEMENT SKILLS
5) 1 in APPLY SAFETY PROCEDURES	

Test Name: TRNSYC02
Scan Form: GPFORMS
Test Label:

Items Measuring TRANS SYS COMPETENCY TWO 2.01A EXP MANAGEMENT SKILLS

1) 1 2) 2 3) 3 4) 4 5) 5 6) 6 7) 8 8) 9
9) 10 10) 11

Items Measuring TRANS SYS COMPETENCY TWO 1.01A EXP TRAN SYS IMPORTANCE

1) 7

Items Measuring TRANS SYS COMPETENCY TWO 2.03A EXP SAFETY PROCEDURES

1) 12 2) 13 3) 14 4) 15 5) 16 6) 17 7) 18 8) 19
9) 20 10) 21 11) 22 12) 23 13) 24 14) 25 15) 26

Items Measuring TRANS SYS COMPETENCY TWO APPLY MANAGEMENT SKILLS

1) 27

Items Measuring TRANS SYS COMPETENCY TWO APPLY SAFETY PROCEDURES

1) 28

Mastery Level for TRANS SYS COMPETENCY TWO Objectives

1) 8 out of 10 for 2.01A EXP MANAGEMENT SKILLS
2) 1 out of 1 for 1.01A EXP TRAN SYS IMPORTANCE
3) 11 out of 15 for 2.03A EXP SAFETY PROCEDURES
4) 1 out of 1 for APPLY MANAGEMENT SKILLS
5) 1 out of 1 for APPLY SAFETY PROCEDURES

Partial Level for TRANS SYS COMPETENCY TWO Objectives

1) 6 out of 10 for 2.01A EXP MANAGEMENT SKILLS
2) 1 out of 1 for 1.01A EXP TRAN SYS IMPORTANCE
3) 9 out of 15 for 2.03A EXP SAFETY PROCEDURES
4) 1 out of 1 for APPLY MANAGEMENT SKILLS
5) 1 out of 1 for APPLY SAFETY PROCEDURES

DIRECTIONS FOR MULTIPLE-CHOICE ITEMS: Read each of the following multiple-choice items and the possible answers carefully. Mark the letter of the correct answer on your answer sheet or as instructed by your teacher. **REMEMBER: MAKE NO MARKS ON THIS TEST.**

1 The depth a vessel sits in the water is referred to as its:
A. Ballast.
B. Displacement.
C. Draft.
D. Lift.

2 Hydraulic systems control and transmit energy through:
A. Fluids.
B. Gases.
C. Solids.
D. Hydrometers.

3 The three axes upon which an aircraft rotates are: roll, pitch, and:
A. Rise.
B. Wave.
C. Lift.
D. Yaw.

4 Large amounts of energy are lost in machinery because of:
A. Displacement.
B. Drag.
C. Friction.
D. Efficiency.

5 Air that slows down a speeding automobile, forcing the driver to accelerate to maintain a steady speed is called:
A. Planetary force.
B. Residual friction.
C. Aerodynamic drag.
D. Acceleration constant.

6 A vessel is guided through its designated sea-lane by using techniques of:
A. Waterways.
B. Navigation.
C. Drafting.
D. Barging.

7 If a boat is moving 32 miles per hour, its speed in knots is approximately:
A. 3 knots.
B. 36.8 knots.
C. 64 knots.
D. 72.6 knots.

GO TO NEXT PAGE

8 The equator is located at:
A. 180° latitude.
B. 180° longitude.
C. 0° longitude.
D. 0° latitude.

9 A good example of how torque can be multiplied is a:
A. Drum brake.
B. "Maglev" train.
C. Door knob.
D. Latch.

10 If a boat is moving 32 miles per hour (mph), its speed in knots is:
A. 36.8 knots.
B. 27.82 knots.
C. 0.03 knots.
D. 33.15 knots.

11 Power can be measured using the following formula:
A. P = w x t.
B. P = t/w.
C. P = w/t.
D. P = t + w.

12 If 80 units of work are applied to a mechanical system that lifts 20 units of weight, the system is said to be:
A. 4% efficient.
B. 25 % efficient.
C. 40 % efficient.
D. 100 % efficient.

13 The greater the amount of water displaced by the hull of a ship the greater the vessel's:
A. Buoyancy.
B. Speed.
C. Floatation
D. Draft.

14 The formula for calculating the actual mechanical advantage is:
A. Output / input.
B. Productivity x efficiency.
C. Input / output.
D. Efficiency / productivity.

15 The upward force that an airplane's wings produce to keep it in the air is called:
A. Lift.
B. Pressure.
C. Thrust.
D. Suspension.

GO TO NEXT PAGE

16 "The amount of work accomplished in a given period of time" is a good definition of:
A. Effort.
B. Energy.
C. Power.
D. Torque.

17 Wind and water currents can force a ship to stray from its intended path. This is called:
A. Yawing.
B. Rolling.
C. Pitching.
D. Keeling.

18 The equation for force is:
A. Length x distance.
B. Length x weight.
C. Pressure x distance.
D. Pressure x area.

19 A satellite put into orbit will continue to orbit at a constant speed, unless acted upon by another force. The satellite's orbit is an example of:
A. Newton's first law of motion.
B. Newton's second law of motion.
C. Newton's third law of motion.
D. Newton's fourth law of motion.

20 The spinning movement in an engine is called:
A. Reciprocating motion.
B. Rotary motion.
C. Linear motion.
D. Torque motion.

21 A book sitting on the edge of a desk is an example of:
A. Mechanical energy.
B. Gravitational energy.
C. Kinetic energy.
D. Potential energy.

22 The side to side movement on a boat is called:
A. Pitch.
B. Keel.
C. Tramp.
D. Roll.

23 The two forces which an aircraft must overcome in order to fly are:
A. Gravity and thrust.
B. Drag and gravity.
C. Thrust and lift.
D. Drag and lift.

GO TO NEXT PAGE

24 The energy from a car's engine drives a crankshaft which spins and produces power in the form of:
A. Effort.
B. Friction.
C. Torque.
D. Pressure.

25 Which of the following vessels displaces the LEAST amount of water?
A. Barge
B. Kayak
C. Oil tanker "with full shipment of oil"
D. Tugboat

26 Which force keeps water in a bucket when it is whirled around rapidly?
A. Coefficient of drag
B. Centrifugal force
C. Centripetal force
D. Geosynchrous orbit

27 The force produced by a plane's propulsion system is called:
A. Lift.
B. Acceleration.
C. Thrust.
D. Suspension.

28 A twisting or turning force is called:
A. Centripetal force.
B. Diametric force.
C. Torque.
D. Distortion.

29 Lines of latitude and longitude are used to locate a fixed position on a map. When used together these lines are called:
A. Coordinates.
B. Meridians.
C. Sextants.
D. Intersections.

30 0° longitude is commonly referred to as the:
A. Equator.
B. Prime meridian.
C. International dateline.
D. Navigational marker.

31 The force exerted by a piston having 80 psi and a 14 inch diameter is approximately:
A. 12,320 pounds.
B. 234 pounds.
C. 129 pounds.
D. 25,120 pounds.

GO TO NEXT PAGE

32 In a space vehicle's orbit around the earth, the point at which the vehicle is farthest from the earth is called the:
A. Perigee.
B. Apogee.
C. Exosphere.
D. Mesosphere.

33 A solid object placed in a fluid less dense than itself will:
A. Sink.
B. Float.
C. Condense.
D. None of the above.

34 Which law of motion states that an unbalance of force on a body tends to produce an acceleration in the direction of force?
A. Newton's first law of motion
B. Newton's second law of motion
C. Newton's third law of motion
D. Newton's fourth law of motion

35 Which one of the following would best show a simple chronological outline of a transportation device?
A. Flow chart
B. Bar chart
C. Force field analysis
D. Flow chart

36 The basic unit of measure for power in a transportation device is:
A. Ergs.
B. Horsepower.
C. Watts.
D. Amperes.

37 The straight line motion produced in certain types of heat engines is called:
A. Reciprocating motion.
B. Traverse motion.
C. Linear motion.
D. Alternating motion.

38 The energy required to lift 33,000 pounds exactly 1 foot in 1 minute is:
A. 1/3 Hp.
B. 1 Hp.
C. 3 Hp.
D. 33 Hp.

39 Ailerons control the roll of an aircraft. Roll is rotation along its:
A. Wing-tip to wing-tip axis.
B. Nose to tail axis.
C. Center, top to bottom.
D. Wings.

GO TO NEXT PAGE

40 The depth a vessel sits in the water is referred to as:
A. Draft.
B. Lift.
C. Displacement.
D. Ballast.

41 The force that resists the forward motion of an aircraft is called:
A. Gravity.
B. Thrust.
C. Drag.
D. Lift.

42 During flight, an aircraft can keep increasing its angle of attack until it:
A. Ices.
B. Stalls.
C. Turns over.
D. Crashes.

43 The natural force that tries to pull a plane to the ground is called:
A. Weight.
B. Gravity.
C. Pressure.
D. Drag.

44 Torque is measured in:
A. Watts.
B. Amperes.
C. Foot-pounds.
D. Pounds per square inch.

45 Steering a ship in a zig-zag course to go up wind is a navigational technique known as:
A. Lateen.
B. Rigging.
C. Fore-and-aft.
D. Tacking.

46 The amount of energy a machine or engine successfully converts into usable energy is expressed in terms of the machine or engine's:
A. Motion.
B. Combustion.
C. Power.
D. Efficiency.

47 A crane operator lifts a 1000 pound barrel of nails 40 feet to a second story window in 30 seconds. How much power is used?
A. 40,000 Hp
B. 1333 ft-lb/sec
C. 33.33 lbs/sec
D. .003 Hp

48 The force produced by a plane or rocket's propulsion system is called:
A. Thrust.
B. Lift.
C. Longitudinal.
D. Reciprocating.

49 Which law of motion states that a body or mass in motion tends to remain in motion, unless acted upon by another force?
A. Newton's first law of motion
B. Newton's second law of motion
C. Newton's third law of motion
D. Newton's fourth law of motion

50 The production of electricity through the use of magnets is called electromagnetic:
A. Induction.
B. Radiation.
C. Valence.
D. Flux.

51 The back-and-forth motion used in heat engines is called:
A. Reciprocating motion.
B. Rotary motion.
C. Linear motion.
D. Alternating motion.

52 The device used to measure how much work an engine can produce in a unit of time is called a:
A. Dynamometer.
B. Hydrometer.
C. Tachometer.
D. Torque wrench.

53 Which law of motion states that for every acting force there is an equal and opposite reacting force?
A. Newton's first law of motion
B. Newton's second law of motion
C. Newton's third law of motion
D. Newton's fourth law of motion

54 When north poles of two magnets are brought together, the magnets:
A. Attract each other.
B. Repel each other.
C. Produce a strong electrical current.
D. Produce less magnetic flux.

55 In a space vehicle's orbit around the earth, the point at which the vehicle is closest to the earth is called the:
A. Perigee.
B. Apogee.
C. Exosphere.
D. Mesosphere.

GO TO NEXT PAGE

56 In order to operate clutch and brake devices rely on:
A. Magnetism.
B. Friction.
C. Gravity.
D. Torque.

57 On a ship's propeller the angle of its blades is referred to as its:
A. Pitch.
B. Law.
C. Center.
D. Roll.

58 One knot is equal to approximately:
A. 1.15 miles per hour.
B. 5.5 miles per hour.
C. 10.15 miles per hour.
D. 15.15 miles per hour.

59 A household furnace consumes 50,000 BTUs each hour. The furnace actually outputs 42,000 BTUs into the home during this time. The efficiency of the furnace:
A. 84%.
B. 19%.
C. 92%.
D. 8%.

60 A falling rock is an example of:
A. Mechanical energy.
B. Gravitational energy.
C. Kinetic energy.
D. Potential energy.

61 If a boat is moving 17.25 knots per hour, its speed in miles per hour (mph) is:
A. 15 miles per hour.
B. 5 miles per hour.
C. 25 miles per hour.
D. 45 miles per hour.

62 The lines of force that run between the poles of a magnet are called:
A. Coordinates.
B. Valence lines.
C. Induction waves.
D. Flux.

63 Pneumatic Systems control and transmit energy through:
A. Fluids such as water or oil.
B. Gases such as air.
C. Solids such as copper.
D. Pneumatism.

GO TO NEXT PAGE

DIRECTIONS FOR PERFORMANCE ITEMS See your teacher or test administrator for instructions on completing the following performance item(s).

64 The purpose of this activity is to design, conduct, and evaluate lab experiments relating to scientific and technical principles found in transportation systems in such a way that the information gathered will help you improve the performance of the vehicular systems under study.

Individually or as a member of a team:

I. Design an experiment(s) dealing with an essential transportation vehicle subsystem which directly affects the performance of the vehicular system under study.

II. Conduct the experiment (changing key variables) and collect useful data using appropriate quality tools.

III. Evaluate and draw conclusions using your knowledge of appropriate scientific and technical concepts.

IV. Report your findings in a brief written and oral report to the class.

Your work will be assessed using the following criteria:

		Points
I.	Experiment well designed. Key variables identified. Procedures and tool appropriate.	0-25
II.	Experiment conducted professionally. Measurements accurately measured and recorded.	0-25
III.	Evaluation through and well thought out. Scientific and technical terms accurate and applied appropriately.	0-25
IV.	Written report clear and to the point. Conclusions are logical and follow from evidence. Oral presentation clear, interesting, and instructive.	0-25
	Total Possible Score	0-100 points

STOP HERE

Directions for Item 64

For this activity help the students identify key scientific and technical concepts and principles directly related to the performance of the transportation vehicular systems under study.

For instance, to study concepts and principles of maglev vehicles, the students could design experiments showing how like magnetic poles repel, while unlike poles attract and changing the polarity can cause a vehicle to move. Or students may wish to experiment with super-conductors.

All experiments should be designed to help the student better understand the underlying principles upon which the vehicular system understudy operates and hopefully lead to vehicles which perform better when the student applies what he or she has learned, whether studying magnetic phenomena to improve a maglev vehicles performance or the drag of different shaped block in a water trough.

GO TO NEXT PAGE

Scoring Directions for Test Item 64 Unit 1 Key 64

The student or student teams should be evaluated by their performance in four areas: Design of the experiment, execution of experiment, experiment evaluation, and the written and oral report. Please keep in mind that the process is purposeful and designed to help the student understand basic scientific and technological concepts and principles related to transportation vehicular systems. The student(s) should understand (and be able to apply) what they learn. You may evaluate using the following formula or modify appropriately:

		Points
I.	Experiment well designed. Key variable identified. Procedures and quality tools used appropriately.	0-25
II.	Experiment conducted professionally. Measurements accurately measured and recorded.	0-25
III.	Evaluation through and well thought out. Scientific and technical terms accurate and applied appropriately.	0-25
IV.	Written report clear and to the point. Conclusions are logical and follow from the evidence. Oral presentation clear, interesting, and instructive.	0-25
	Total Possible Score	0-100 points

Test Name: TRNSYC03
Scan Form: GPFORMS
Test Label:

Subtest Name	Number of Items	Number of Objectives	Starting Item Number
TRANS SYS COMPETENCY THREE	64	2	1

Answer Key for TRANS SYS COMPETENCY THREE

1)C	2)A	3)D	4)C	5)C	6)B	7)B	8)D
9)C	10)A	11)C	12)B	13)A	14)A	15)A	16)C
17)A	18)D	19)A	20)A	21)D	22)D	23)B	24)C
25)B	26)B	27)C	28)C	29)A	30)B	31)A	32)B
33)B	34)B	35)D	36)C	37)C	38)B	39)B	40)A
41)C	42)B	43)B	44)C	45)D	46)D	47)B	48)A
49)A	50)A	51)A	52)A	53)C	54)B	55)A	56)B
57)A	58)A	59)A	60)C	61)A	62)D	63)A	64)S

Item Codes for TRANS SYS COMPETENCY THREE

1)003.01.09	2)003.01.02	3)003.01.05	4)003.01.61
5)003.01.16	6)003.01.38	7)003.01.07	8)003.01.36
9)003.01.18	10)003.01.33	11)003.01.20	12)003.01.03
13)003.01.39	14)003.01.25	15)003.01.42	16)003.01.29
17)003.01.19	18)003.01.31	19)003.01.54	20)003.01.47
21)003.01.59	22)003.01.12	23)003.01.23	24)003.01.11
25)003.01.10	26)003.01.15	27)003.01.44	28)003.01.24
29)003.01.01	30)003.01.37	31)003.01.32	32)003.01.56
33)003.01.04	34)003.01.52	35)003.01.35	36)003.01.26
37)003.01.48	38)003.01.06	39)003.01.22	40)003.01.40
41)003.01.41	42)003.01.62	43)003.01.43	44)003.01.27
45)003.01.13	46)003.01.17	47)003.01.21	48)003.01.63
49)003.01.51	50)003.01.50	51)003.01.45	52)003.01.28
53)003.01.53	54)003.01.08	55)003.01.55	56)003.01.30
57)003.01.57	58)003.01.58	59)003.01.14	60)003.01.60
61)003.01.34	62)003.01.49	63)003.01.46	64)003.02.01

Objective Labels for TRANS SYS COMPETENCY THREE

1)3.01A DEFINE SCI CONCEPTS
2)DESIGN AND CONDUCT EXPERIMENTS

Objective Codes for TRANS SYS COMPETENCY THREE

1)003.01A for 3.01A DEFINE SCI CONCEPTS
2)003.02.01 for DESIGN AND CONDUCT EXPERIMENTS

Test Name: TRNSYC03
Scan Form: GPFORMS
Test Label:

Number of Items Measuring each TRANS SYS COMPETENCY THREE Objective

1) 63 in 3.01A DEFINE SCI CONCEPTS 2) 1 in DESIGN AND CONDUCT EXPERIME

Items Measuring TRANS SYS COMPETENCY THREE 3.01A DEFINE SCI CONCEPTS

1) 1	2) 2	3) 3	4) 4	5) 5	6) 6	7) 7	8) 8
9) 9	10) 10	11) 11	12) 12	13) 13	14) 14	15) 15	16) 16
17) 17	18) 18	19) 19	20) 20	21) 21	22) 22	23) 23	24) 24
25) 25	26) 26	27) 27	28) 28	29) 29	30) 30	31) 31	32) 32
33) 33	34) 34	35) 35	36) 36	37) 37	38) 38	39) 39	40) 40
41) 41	42) 42	43) 43	44) 44	45) 45	46) 46	47) 47	48) 48
49) 49	50) 50	51) 51	52) 52	53) 53	54) 54	55) 55	56) 56
57) 57	58) 58	59) 59	60) 60	61) 61	62) 62	63) 63	

Items Measuring TRANS SYS COMPETENCY THREE DESIGN AND CONDUCT EXPERIMENTS

1) 64

Mastery Level for TRANS SYS COMPETENCY THREE Objectives

1) 47 out of 63 for 3.01A DEFINE SCI CONCEPTS
2) 1 out of 1 for DESIGN AND CONDUCT EXPERIMENTS

Partial Level for TRANS SYS COMPETENCY THREE Objectives

1) 38 out of 63 for 3.01A DEFINE SCI CONCEPTS
2) 1 out of 1 for DESIGN AND CONDUCT EXPERIMENTS

DIRECTIONS FOR MULTIPLE-CHOICE ITEMS: Read each of the following multiple-choice items and the possible answers carefully. Mark the letter of the correct answer on your answer sheet or as instructed by your teacher. **REMEMBER: MAKE NO MARKS ON THIS TEST.**

1 Subways did not become common until:
A. Steam engines were developed.
B. Steel track was perfected.
C. Electric power was used for propulsion.
D. Switching systems were developed allowing for faster trains.

2 On April 12, 1961 the Russians succeeded in:
A. Testing the first hydrogen bomb.
B. Launching their first nuclear submarine.
C. Successfully orbiting the first man (Yuri Gagarin) in space.
D. Successfully completing the first Lunar non-manned space flight.

3 By the year 1900, the U.S. had about 200,000 miles of railroads being used. The principal advantage(s) of rail verses horse-drawn wagons is that rail transportation is:
A. More expensive, but faster.
B. More expensive, but more reliable.
C. Less expensive, more reliable, and faster.
D. None of the above.

4 Setting the stage for advanced communication technology, on October 4, 1957:
A. Sputnik 1 was launched into orbit.
B. The communication satellite system for Star Wars went into operation.
C. The first Trans-Atlantic fiber cable was completed.
D. The first micro-wave communication system went into operation.

5 It is generally agreed that the first transportation device was the:
A. Camel
B. Dugout boat.
C. Horse.
D. Wheelbarrow.

6 This device greatly improved the efficiency and freedom of movement of sailboats:
A. The forward beam rudder.
B. Solid ballast.
C. The square-rigged sail.
D. The lateen sail.

7 On July 21, 1969 Neil Armstrong and Edwin Aldrin became the first men to:
A. Join the Soviet Union in a joint space operation.
B. Travel faster than the speed of sound.
C. Dive more than one mile beneath the Atlantic Ocean's surface.
D. Walk on the moon.

GO TO NEXT PAGE

8 Space flights such as the Mariner, and Pioneer series allow:
A. Information to be gathered from distances which today are too far for manned flight.
B. Weapons to be dropped in the event of a nuclear war.
C. For joint space missions between the U.S. and Russia.
D. Astronauts to remain in space for over three months.

9 When people used animals for transportation, the fastest they could go was about 40 miles (64 kilometers) per hour. Today, modern jet aircraft such as the 500-seat Boeing 747 travel up to:
A. 100 miles per hour.
B. 150 miles per hour.
C. 300 miles per hour.
D. 600 miles per hour.

10 One of the most important navigational tools for early sailors helped determine a ships latitude through the sighting of the sun or a star. This instrument was the:
A. Compass.
B. Load stone.
C. Quadrant.
D. Log.

11 In 1903 one of the most important events in the history of man took place when the Wright brothers:
A. Powered the first steamboat.
B. Traveled across the Atlantic in a hot-air balloon.
C. Produced the first internal combustion engine.
D. Flew the first successful engine-powered airplane.

12 One of the great advantages of using pack animals such as the camel to carry goods is that:
A. Camels have an excellent sense of direction.
B. Pack animals need no water during trips across deserts.
C. Camels can carry much more (over 1000 lbs) than a human can carry.
D. All the above.

13 The invention of the compass helped sailors:
A. Identify their latitude.
B. Identify their longitude.
C. Maintain a constant speed.
D. Maintain a constant course.

14 The Model-T Ford is of historical importance because:
A. It represents the first relatively inexpensive car available to millions.
B. It was the first mass produced car to be built using standardized parts.
C. It gave millions freedom of movement never before known to the average citizen.
D. All the above.

GO TO NEXT PAGE

15 Sailing ships gave way to steamships mainly because:
A. Sailing ships were more expensive to operate because of the greater number of men required to operate them.
B. Sailing ships were more limited in size than steamships.
C. Steamships had a more reliable power source.
D. All the above.

16 Which type of engine was a central feature of the Industrial Revolution?
A. Reaction engine
B. Diesel engine
C. Steam engine
D. Rotary engine

17 The major effect of roads such as the ones built by the Romans and the modern roads and highways which followed, is that they greatly:
A. Increased trade.
B. Quickened communication.
C. Improved the movement of armies and supplies.
D. All the above.

DIRECTIONS FOR PERFORMANCE ITEMS See your teacher or test administrator for instructions on completing the following performance item(s).

18 As an individual or member of a team, first conduct research, then design, conduct, and evaluate laboratory experiments relating to the evolution of a transportation vehicular system or subsystem. Write a brief report, include sketches and technical drawings, and your research resources. Report your findings to your class.

The purpose of this activity is for you to develop a better understanding of the evolution of transportation systems and how the specific system or subsystem understudy improved the performance of previously existing systems or subsystems.

Use the skills and insights learned from your previous experimentation on scientific and technical principles related to transportation vehicular systems.

You will be assessed using the following criteria:

	Points
I. Research (Well researched and focused)	0-20
II. Experiment (Well designed and conducted)	0-30
III. Report (Well written, complete, and technically correct)	0-30
IV. Presentation (Clear, well organized and interesting)	0-20
Total Possible Score	0-100 points

STOP HERE

Directions for Item 18

Using the knowledge and insights gained from their previous experiments, the students should research an important transportation historical development. The students should conduct and evaluate laboratory experiments related to this development and present their finds to the class.

GO TO NEXT PAGE

Scoring Directions for Test Item 18 Unit 1 Key 18

Have the students working individually or in small teams conduct research, design, conduct, and evaluate laboratory experiments related to the evolution of a transportation vehicule system as well as develop a report which includes sketches, drawings and a bibliography of research text. Finally have the students present their finds to the rest of the class.

Incourage the students to use the skills they have already learned from the previous laboratory experiments. An example of an activity could be experimental inquiry into the different levels of force (lift) created by different type sails. Does the latteen sail work more efficiently at different angles to the wind than other designs?

Assess the students using the following criteria or modify appropriately:

		Points
I.	Research is through and focused	0-20
II.	Experiment has been well thoughtout and conducted. Measurements are accurate and recorded correctly using appropriate quality tools.	0-30
III.	Report is well written, complete, and technically correct. Bibliography, sketches and appropriate drawings are included.	0-30
IV.	Presentation is clear, well organized, interesting with necessary supporting graphics.	0-20
	Total Possible Score	0-100

GO TO NEXT PAGE

Test Name: TRNSYC04
Scan Form: GPFORMS
Test Label:

Subtest Name	Number of Items	Number of Objectives	Starting Item Number
TRANS SYS COMPETENCY FOUR	18	2	1

Answer Key for TRANS SYS COMPETENCY FOUR

1)C	2)C	3)C	4)A	5)B	6)D	7)D	8)A
9)D	10)C	11)D	12)C	13)D	14)D	15)D	16)C
17)D	18)S						

Item Codes for TRANS SYS COMPETENCY FOUR

1)004.01.11	2)004.01.07	3)004.01.16	4)004.01.09
5)004.01.02	6)004.01.04	7)004.01.08	8)004.01.10
9)004.01.06	10)004.01.01	11)004.01.03	12)004.01.12
13)004.01.14	14)004.01.05	15)004.01.15	16)004.01.17
17)004.01.13	18)004.02.01		

Objective Labels for TRANS SYS COMPETENCY FOUR

1)4.01A EXP TRAN SYS DEVELOPMENT 2)CONDUCT HISTORICAL EXPERIMENTS

Objective Codes for TRANS SYS COMPETENCY FOUR

1)004.01A	for 4.01A EXP TRAN SYS DEVELOPMENT
2)004.02	for CONDUCT HISTORICAL EXPERIMENTS

Number of Items Measuring each TRANS SYS COMPETENCY FOUR Objective

1) 17 in 4.01A EXP TRAN SYS DEVELOPMENT 2) 1 in CONDUCT HISTORICAL EXPERIME

Items Measuring TRANS SYS COMPETENCY FOUR 4.01A EXP TRAN SYS DEVELOPMENT

1) 1	2) 2	3) 3	4) 4	5) 5	6) 6	7) 7	8) 8
9) 9	10) 10	11) 11	12) 12	13) 13	14) 14	15) 15	16) 16
17) 17							

Items Measuring TRANS SYS COMPETENCY FOUR CONDUCT HISTORICAL EXPERIMENTS

1) 18

Test Name: TRNSYC04
Scan Form: GPFORMS
Test Label:

Mastery Level for TRANS SYS COMPETENCY FOUR Objectives

1) 13 out of 17 for 4.01A EXP TRAN SYS DEVELOPMENT
2) 1 out of 1 for CONDUCT HISTORICAL EXPERIMENTS

Partial Level for TRANS SYS COMPETENCY FOUR Objectives

1) 10 out of 17 for 4.01A EXP TRAN SYS DEVELOPMENT
2) 1 out of 1 for CONDUCT HISTORICAL EXPERIMENTS

DIRECTIONS FOR MULTIPLE-CHOICE ITEMS: Read each of the following multiple-choice items and the possible answers carefully. Mark the letter of the correct answer on your answer sheet or as instructed by your teacher. **REMEMBER: MAKE NO MARKS ON THIS TEST.**

1 With the exception of steam-powered ships, most transportation devices are powered by:
A. External combustion engines.
B. Stirling engines.
C. Internal combustion engines.
D. Reciprocating engines.

2 Most ships are propelled by:
A. Rotary engines.
B. Stirling engines.
C. Diesel engines.
D. Reaction engines.

3 On a sailboat, which sail is placed opposite or alongside the mainsail?
A. Jib
B. Spinnaker
C. Airfoil
D. Lateen

4 Which type of steam engine passes a heated gas back and forth between two cylinders?
A. Reciprocating
B. Steam turbine
C. Piston
D. Stirling

5 Which of the following is/are an example of an "internal combustion engine"?
A. Universal-induction engine
B. Stirling engine
C. Ramjet engine
D. All the above

6 The major source of energy for transportation systems is:
A. Nuclear energy.
B. Electricity.
C. Solar energy.
D. Petroleum.

7 Which of the following engines is an example of an external combustion engine?
A. Diesel engine
B. Steam engine
C. Wankel engine
D. Rocket engine

GO TO NEXT PAGE

8 Which of the following is an advantage of liquid-propellant engines?
A. Power output can be regulated
B. Fuel is not pumped to a combustion chamber
C. Engine design determines power output and duration
D. Engine design is simple enough to be used in model rockets

9 A device that uses steam to produce rotary motion is called a(n):
A. Auxiliary steam engine.
B. Stirling cycle engine.
C. Steam turbine engine.
D. Reciprocating engine.

10 Transportation companies have been experimenting with new vehicles that use electromagnetic principles for propulsion and suspension. These systems are generally called:
A. Third rail systems.
B. Maglevs.
C. Electroprops.
D. Polarization Modules.

11 In internal combustion engines, pistons produce a:
A. Reciprocating motion.
B. Rotary motion.
C. Circular motion.
D. Linear motion.

12 The output of a linear-motion engine, such as a jet engine, is measured as:
A. Velocity.
B. Distance.
C. Torque.
D. Thrust.

13 The output of a reciprocating or rotary engine is always measured as:
A. Velocity.
B. Distance.
C. Torque.
D. Thrust.

14 The four separate piston strokes in a four-stroke cycle engine are compression, exhaust, power, and:
A. Intake.
B. Ignition.
C. Combustion.
D. Consumption.

15 Most large trucks are propelled by:
A. Diesel engines.
B. Ramjet engines.
C. Turbine engines.
D. Rotary engines.

GO TO NEXT PAGE

16 Which type of sail improved the maneuverability of ships and encouraged increased exploration of uncharted land?
A. Square-rigged
B. Lateen
C. Dhow
D. Slant-rigged

17 All nuclear-fueled ships in the United States Navy are powered by:
A. Reciprocating engines.
B. Steam turbine engines.
C. Piston engines.
D. Stirling engines.

18 Turboprop engines are mainly used to power:
A. Guided missiles.
B. Military aircraft.
C. Commercial airliners.
D. Small business planes.

19 An example of an external combustion engine is the:
A. Reaction engine.
B. Diesel engine.
C. Steam engine.
D. Rotary engine.

20 Diesel - electric propulsion systems are most commonly found in:
A. Ship engines.
B. Aircraft engines.
C. Truck engines.
D. Train engines.

21 Many aircraft are propelled by:
A. Stirling engines.
B. Piston engines.
C. Steam engines.
D. Rotary engines.

22 The most powerful internal combustion engines are:
A. Rotary engines.
B. Rocket engines.
C. Jet engines.
D. Diesel engines.

23 Friction and centrifugal are two common types of:
A. Clutches.
B. Step pulleys.
C. Gear teeth.
D. Drive shafts.

GO TO NEXT PAGE

24 Fuel is ignited by the intense heat of compression in:
A. Rotary engines.
B. Gasoline engines.
C. Diesel engines.
D. Four-stroke cycle engines.

25 Gas turbine engines are exposed to:
A. Extreme cold.
B. High temperatures.
C. Heavy moisture.
D. Heavy vibration.

26 The most powerful internal combustion engine is the:
A. Steam engine.
B. Diesel engine.
C. Jet engine.
D. Rocket engine.

27 The main difference between solid rocket engines and liquid rocket engines is:
A. The amount of thrust produced is greater in a solid rocket.
B. Liquid rockets are heavier.
C. Solid rockets are no longer used.
D. A liquid rocket engine may be throttled to control thrust.

28 On a sailboat the majority of the wind is captured by the:
A. Mainsail.
B. Lateen.
C. Jib.
D. Spinnaker.

29 Nearly all automobiles are powered by:
A. Wankel engines.
B. Stirling engines.
C. Gasoline engines.
D. Two-stroke cycle engines.

30 What do many automobiles use to transfer power from the engine to the differential?
A. Pistons
B. Step pulleys
C. Gear teeth
D. Drive shafts

31 The action in a jet engine is:
A. Continuous.
B. Non-continuous.
C. Reciprocating.
D. In the form of torque.

GO TO NEXT PAGE

32 Jet engines are:
A. Open at both ends.
B. Closed at both ends.
C. Open for intake only.
D. Open for exhaust only.

33 On a ship's propeller, a lower pitch causes:
A. Greater speed.
B. Greater pulling power.
C. Lower pulling power.
D. Greater slip ratio.

34 On a ship's propeller a pitch of 17 means that the propeller will:
A. Turn at 17 RPM's.
B. Be at 17° to the ship shaft.
C. Push at 17 ft/lbs.
D. Move forward 17" with each revolution.

35 Wankel engines produce a:
A. Linear motion.
B. Rotary motion.
C. Reciprocating motion.
D. Alternating motion.

36 About what percentage of energy produced by burning diesel oil in a diesel engine is converted into motion?
A. 40%
B. 5%
C. 50%
D. 70%

37 Motion that produces a desired outcome including the factors force times distance is:
A. Effort.
B. Energy.
C. Power.
D. Work.

38 How energy efficient are heat engines?
A. Less than 50% efficient
B. Between 50 and 70% efficient
C. Between 70 and 90% efficient
D. Approximately 95% efficient

39 One of the least efficient but most widely used energy conversion devices for transportation is the:
A. External rotary combustion engine.
B. Internal combustion engine.
C. Automatic transmission.
D. Electric motor.

GO TO NEXT PAGE

40 The greatest advantage of the diesel engine is its:
A. Large size.
B. Heavy structure.
C. Durable casing.
D. Fuel economy.

41 On turbofan engines, the fans provide an additional source of:
A. Exhaust.
B. Torque.
C. Thrust.
D. Lift.

42 Two-stroke cycle and four-stroke cycle are types of:
A. Turbojet engines.
B. Gasoline piston engines.
C. Jet engines.
D. Rotary engines.

43 In a turboprop engine nearly all of the energy produced by burning fuel is used to operate the:
A. Compressor and propeller.
B. Propeller and forward thrust.
C. Compressor and reverse thrust.
D. Forward and reverse thrust.

44 The "Stirling" engine is:
A. A theoretical device.
B. A steam engine.
C. Two times less efficient than a gasoline engine.
D. Used in many of today's automobiles.

45 Rocket engines such as those used on the space shuttle are:
A. External combustion engines.
B. Internal combustion engines.
C. Rotary engines.
D. Adapted jet engines.

46 On a sailboat, which sail is set forward of the mainsail?
A. Jib
B. Spinnaker
C. Airfoil
D. Lateen

47 Diesel engines are known for:
A. Low weight.
B. Power and dependability.
C. High operating costs.
D. Maintenance problems.

GO TO NEXT PAGE

48 Which of the following is **NOT** an internal combustion engine?
A. Diesel
B. Steam
C. Wankel
D. Rocket

49 The ramjet engine is the simplest of all reaction engines and is basically a(n):
A. Hollow tube.
B. Exhaust system.
C. Compressor turbine.
D. Hollow sphere.

50 Gas turbine engines are used to power:
A. Small business airplanes.
B. Commercial airliners.
C. Lawn mowers.
D. Ships.

51 The force that propels an inflated balloon around a room demonstrates the same principles as a:
A. Diesel engine.
B. Piston engine.
C. Wankel engine.
D. Jet engine.

52 The action in a jet engine is:
A. Reciprocating.
B. Torque.
C. Continuous.
D. Not continuous.

53 An example of an internal combustion engine which produces a linear motion is a:
A. Turbojet engine.
B. Gasoline piston engine.
C. Jet engine.
D. Rotary engine.

54 Which of the following is an advantage of solid-propellant engines?
A. Fuel and oxygen are ignited in a combustion chamber
B. Power output can be regulated
C. Fuel is not pumped to a combustion chamber
D. Kerosene is the primary source of fuel

55 The diesel fuel in modern locomotive engines is burned in an engine which is used to:
A. Turn a generator to make electricity.
B. Turn a large, multi-speed transmission to power the wheels.
C. Power the compressor section of the turbine drive engine.
D. Power the wheels through a special fluid turbine transmission.

GO TO NEXT PAGE

56 Turbofan engines are used to power:
A. Guided missiles.
B. Military aircraft.
C. Commercial airliners.
D. Small business planes.

57 Liquid-propellant and solid-propellant are types of:
A. Rotary engines.
B. Rocket engines.
C. Jet engines.
D. Diesel engines.

58 Ramjet engines are used mainly to power:
A. Missiles.
B. Military helicopters.
C. Commercial airlines.
D. Small business planes.

59 The Wankel engine is:
A. A type of internal combustion engine.
B. A type of external combustion engine.
C. Obsolete.
D. A type of rocket engine.

60 Steering wheels, brakes, and automatic pilots are all examples of transportation:
A. Control systems.
B. Support systems.
C. Suspension systems.
D. Structural systems.

61 The positioning of a wheel such that it contacts the road behind the centerline of the steering axis is referred to as:
A. Caster.
B. Mono-steering.
C. Multi-directional.
D. Positive axle steering

62 Most modern automobiles have a positive camber which:
A. Can dramatically increase the speed of the car.
B. Can dramatically increase the braking distance of the car.
C. Can reduce the wear on bearings and axles.
D. Make them more dangerous to drive.

63 An airplane relies on:
A. An elevator to change pitch.
B. An aileron to change pitch.
C. A rudder to change pitch.
D. An fuselage to change pitch.

GO TO NEXT PAGE

64 Mechanical devices that control the separation and joining of power to drive systems are:
A. Differentials.
B. Drive shafts.
C. Clutches.
D. Brakes.

65 If one aileron were lowered and the other raised, the plane would:
A. Dive.
B. Climb.
C. Roll.
D. Stall.

66 Tanks and bulldozers can change direction by:
A. Engaging trusters.
B. Engaging directional control wheels.
C. Making one track go faster than another.
D. Reversing their transmission.

67 How many degrees of freedom does a train have?
A. One
B. Two
C. Three
D. Four

68 Systems which provide for multiplying, dividing, or reversing the mechanical power coming from engines or motors are called:
A. Transmission systems.
B. Suspension systems.
C. Hydraulic systems.
D. Pneumatic systems.

69 Caster is desired in a steering system because it:
A. Is considerably less expensive.
B. Is easier to maintain.
C. Is considerably stronger than conventional methods.
D. Makes it much easier to steer the vehicle.

70 The small rotor on the rear of a helicopter is used to offset what forces caused by the main rotor?
A. Pitch
B. List
C. Roll
D. Torque

71 To control direction, which vehicles use a fixed rail system?
A. Cars
B. Trucks
C. Planes
D. Trains

GO TO NEXT PAGE

72 Rockets use which of the following to change direction?
A. Rudder
B. Aileron
C. Nozzle direction
D. All the above

73 The "camber" of a wheel refers to:
A. The amount of traction it has.
B. The wheels suspension properties.
C. The angle it is to the road.
D. The number of "layers" or "belts" it has.

74 How many degrees of freedom does a helicopter have?
A. One
B. Two
C. Three
D. Four

75 Hot air balloons:
A. Control direction by using rudders.
B. Control speed by propellers.
C. Control altitude by the amount of hot air in the balloon.
D. Control altitude and direction through the use of thrusters and ballast.

76 Control systems are designed to control a vehicles position in space, and:
A. Speed and direction.
B. Support it in its environment.
C. Determine danger.
D. Protect passengers from the surrounding environment.

77 Which of the following gear systems would provide the most pushing power for a towtruck?
A. A motor turning a small gear driving a small gear driving the rear wheels
B. A motor turning a small gear driving a large gear driving the rear wheels
C. A motor turning a large gear driving a large gear driving the rear wheels
D. A motor turning a large gear driving a small gear driving the rear wheels

78 To change direction, one changes the cyclical pitch on a:
A. Car.
B. Boat.
C. Airplane.
D. Helicopter.

79 Drum and disc are two types of:
A. Suspension systems.
B. Propulsion systems.
C. Transmission systems.
D. Brake systems.

GO TO NEXT PAGE

80 To increase the speed of different types of vehicles one may:
A. Increase the fuel consumption of the engine.
B. Change sail position.
C. Change the pitch or speed of the propeller.
D. Do any of the above.

81 To steer a boat one must turn the:
A. Elevator.
B. Stabilizer.
C. Keel.
D. Rudder.

82 In control systems, the number of changes in direction a vehicle can make is called:
A. Degrees of freedom.
B. Directional degrees.
C. Mobility.
D. Maneuverability.

83 On aircraft, the longitudinal axis, "roll" is controlled by the:
A. Fuselage.
B. Elevators.
C. Rudder.
D. Ailerons.

84 Which device allows an airplane to change its compass heading?
A. Ailerons
B. Fuselage
C. Rudder
D. Tail

85 Pneumatic tires are filled with:
A. Oil.
B. Air.
C. Water.
D. Pneumatium.

86 A boat that rises above the surface of the water on "wings" that remain in the water is called a/n:
A. Planer.
B. Jet-ski.
C. Hydrofoil.
D. Air-boat.

87 Both balloons and boats are kept afloat by the:
A. Gravitational forces acting on them.
B. Trust created by their engines.
C. Buoyancy of their vehicles.
D. Lift created by their foils.

GO TO NEXT PAGE

88 Lift on a helicopter is created by the:
A. Props.
B. Elevators.
C. Rotor blades.
D. Airfoils.

89 An aircraft is suspended in air by its wings. This is made possible by the lift which is made by:
A. The air moving more quickly under its wings.
B. The air moving more quickly over the top of its wings.
C. The buoyancy of the vehicle in relation to the air around it.
D. The coefficient of drag created by the thrust of its engines.

90 What is used to give blimps lift?
A. Hot air
B. Hydrogen
C. Oxygen
D. Helium

91 A stabilizer bar prevents:
A. An aircraft from bumps caused by erratic winds.
B. Ships from excessive roll.
C. Trains from leaving the track at high speeds.
D. Cars from leaning out too far when turning.

92 Flat, round, catamaran, and hydrofoils are all types of:
A. Boat.
B. Wing designs.
C. Hull designs.
D. Plenum chambers.

93 Pneumatic tires provide a cushioning effect because:
A. Air compresses.
B. Oil compresses.
C. Water compresses.
D. Pneumatium compresses.

94 Annular jets and plenum chambers are found on:
A. Boats.
B. Air cushioned vehicles.
C. Military rockets.
D. Nuclear submarines.

95 All heavier-than-air aircraft rely on:
A. Propellers to provide thrust.
B. Rotors to provide lift.
C. Wings to fly.
D. Airfoils to provide lift.

GO TO NEXT PAGE

96 Hydroplaning may cause a vehicle to:
A. Increase its speed.
B. Loose altitude.
C. Go out of control.
D. Decrease its angle of attack.

97 Which type of boat hull is designed to skim on the surface of the water once the boat reaches its optimum speed?
A. Displacement
B. Planeing
C. Hydrofoil
D. Air cushioned

98 The four forces affecting a plane in flight are the lift, weight (gravity), thrust, and:
A. Propulsion.
B. Compression.
C. Combustion.
D. Drag.

99 Land suspension systems are made up of tires, springs, shock absorbers, and:
A. T-props.
B. Steering cables.
C. Stabilizer bars.
D. Centering drivers.

100 The buoyancy of submarines are controlled by:
A. Its rudder.
B. Speed.
C. Inflation tubes.
D. Flotation tanks.

101 Which of the following hulls is the most stable?
A. Round bottom
B. Flat bottom
C. Semi-Vee bottom
D. Catamarans and tri-hulls

102 The boats which tend to be the LEAST stable have:
A. Round hulls.
B. Flat bottom hulls.
C. Tri-hulls.
D. Semi-Vee bottom hulls.

103 A hydrofoil is lifted out of the water by:
A. Thrusters.
B. A cushion of air.
C. The lift created by its foils.
D. Its propellers.

GO TO NEXT PAGE

104 The main purpose of a shock absorber is to:
A. Reduce damage resulting from a head-on collision.
B. Reduce spring oscillation.
C. Reduce torque forces of an engine.
D. Reduce the braking forces of air brakes.

105 The major advantage of air cushion vehicles such as Hovercraft is that they:
A. Can travel over land and water.
B. Can go very fast.
C. Can go very high.
D. Are extremely stable in storms.

106 The body of an airplane is called a:
A. Chamber.
B. Compartment.
C. Fuselage.
D. Cabin.

107 A conning tower is found:
A. At airports.
B. On tugboats.
C. Most catamarans.
D. On submarines.

108 In marine vessels, the hull designed to carry heavy loads is called a:
A. Displacement hull.
B. Planing hull.
C. Delta hull.
D. Conical hull.

109 What part of a marine vessel's hull improves ride during roll and reduces splashing over the bow?
A. Fore
B. Conical contour
C. Delta shape
D. Chine

110 Bulkheads serve to:
A. Isolate sections of the ship to prevent sinking.
B. Storage fuel and other fluids.
C. Store bulk materials such as coal and grains.
D. Tie cargo down to prevent it from moving during storms.

111 Ailerons, flaps, elevators, and rudders cause the plane to move by:
A. Increasing or decreasing drag.
B. Increasing or decreasing lift.
C. Increasing or decreasing the plane's center of weight.
D. Increasing or decreasing the plane's center of effort.

GO TO NEXT PAGE

112 The pilot and other operators of large plane are located in the planes:
A. Cockpit.
B. Pilothouse.
C. Conning tower.
D. Control tower.

113 The empennage of a plane is its:
A. Wing(s).
B. Nose section.
C. Tail section.
D. Fuselage.

114 The primary purpose of a planes tail section is to provide:
A. Baggage space.
B. Fuel Storage.
C. Control and stability.
D. Added lift.

115 The two main parts of a hot air balloon are the:
A. Fuselage and cabin.
B. Fuselage and cockpit.
C. Envelope and car (basket).
D. Car (basket) and shroud.

116 Stages are parts of:
A. Luxury cars.
B. Buses.
C. Rockets.
D. Trains.

117 Larger cars generally have conventional frames, tend to be safer, and:
A. Tend to rattle more.
B. Tend to be quieter.
C. Tend to be more fuel efficient.
D. Tend to be less expensive because of conventional rather than unibody construction.

118 The main body of a marine vessel is call a/n:
A. Conical.
B. Cabin.
C. Deck.
D. Hull.

119 The main two parts of an automobile structure are the:
A. Truss and frame.
B. Body and wheels.
C. Body and chassis.
D. Cab and engine compartment.

GO TO NEXT PAGE

120 Ceramic tiles are used on the space shuttle to:
A. Reduce friction.
B. Reduce drag.
C. Protect against heat.
D. Increase the lift during the re-entry process.

121 In marine vessels, the hull designed to ride on top of the water for increased speed is called a:
A. Displacement hull.
B. Planing hull.
C. Delta hull.
D. Conical hull.

122 What part of a marine vessel's hull is designed to provide clean cutting through the water for optimum water flow and minimum drag?
A. Fore
B. Conical contour
C. Delta shape
D. Chine

123 The term monocoque means:
A. Hollow.
B. Strong.
C. One shell.
D. Many chambers.

124 What part of a marine vessel's hull provides stability and makes it easier to plane the boat?
A. Fore
B. Conical contour
C. Delta shape
D. Chine

125 The main advantage of monocoque design for plane fuselages is that this design:
A. Provides considerably more storage space than truss design.
B. Is much less expensive to build than truss design.
C. Is much less in weight than truss design.
D. None of the above.

126 One of the major disadvantages of plastics verses steel in car construction, is that plastics:
A. Do not withstand impact as well as steel.
B. Tend to weight more than steel.
C. Have a higher coefficient of drag.
D. All the above.

127 Unibody, truss system, and monocoque all refer to:
A. Suspension systems.
B. Control systems.
C. Structural systems.
D. Bridge designs.

GO TO NEXT PAGE

128 A jet fighter is most likely to have a:
A. Straight wing.
B. Tapered wing.
C. Elliptical wing.
D. Sweptback or delta wing.

129 Straight, tapered, elliptical, and sweptback refer to:
A. Hulls.
B. Car bodies.
C. Train designs.
D. Wings.

130 The location of radio transmitters can be seen on:
A. Aeronautical charts
B. Nautical charts.
C. Road maps.
D. Tourist maps.

131 This method uses a compass to read the bearings of visible landmarks and a chart to determine the vehicles location:
A. Dead reckoning.
B. Piloting.
C. Circumnavigation.
D. VOR.

132 A method for determining a vehicles's position by estimating how far and in what direction it has come from its last known position is called:
A. Radio sextant application.
B. Piloting.
C. Gyro-compassing method.
D. Dead reckoning.

133 This device continuously measures radio waves given off by the sun to determine the position of the vehicle:
A. Gyrocompass.
B. VOR.
C. IEC (Integrated Electronic Compass).
D. Radio sextant.

134 On average, magnetic north differs from true north by approximately:
A. 1000 miles north.
B. 1000 miles south.
C. 11 miles north.
D. 11 miles south.

135 Church steeples and water towers can frequently be seen on:
A. Aeronautical charts.
B. Nautical charts.
C. Road maps.
D. Tourist maps.

GO TO NEXT PAGE

136 This guidance system sends out radio waves which bounce off objects and return to a receiver which then determines how far away the objects are:
A. Sonar.
B. Radar.
C. Loran.
D. Omega.

137 The device attached to the drive train of land transportation vehicles that measures speed in miles or kilometers is called a:
A. Log.
B. Sextant.
C. Speedometer.
D. Altimeter.

138 The navigational system that employs up to five satellites is:
A. VOR.
B. Loran.
C. Omega.
D. NAVSAT.

139 On a scaled map, what decreases as the denominator in the ratio increases?
A. Detail
B. Land Area
C. Numerator
D. Chart size

140 A map that is shaped like a sphere is called a/n:
A. Log.
B. Nautical chart.
C. Globe.
D. VOR

141 What guidance device would the average person use to travel across the United States in a car?
A. Compass
B. Light
C. Map
D. Radio

142 How many longitudinal degrees are measured on the globe?
A. 66
B. 90
C. 180
D. 360

143 The development of what instrument allowed early ocean navigators to cross wide bodies of water without having to rely on landmarks?
A. The sundial
B. The telescope
C. The compass
D. The hydrometer

GO TO NEXT PAGE

144 Which of the following is an example of a guidance system?
A. Jib
B. Wheel
C. Road sign
D. Rudder

145 A ship would use which of the following to determine the waters depth?
A. Sonar
B. Radar
C. Loran
D. Omega

146 Radio transmitting stations are usually land-based and controlled by the:
A. City or town government.
B. County government.
C. State government.
D. Federal government.

147 What navigational device is designed to point to true north?
A. Sextant
B. Compass
C. Gyrocompass
D. Sonar

148 The relationship of large land masses such as the North American Continent, can be seen on a:
A. Globe.
B. Aeronautical chart.
C. Nautical chart.
D. Sextant.

149 The navigational system having a very high frequency omnidirectional range is:
A. VOR.
B. Loran.
C. Omega.
D. NAVSAT.

150 Guidance systems give a vehicle's operator warning signals, direction, and:
A. Location.
B. Pressure.
C. Speed.
D. All the above.

151 Stop lights, lighthouses, and buoys are all parts of:
A. Suspension systems.
B. Control systems.
C. Guidance systems.
D. Structural systems.

152 Air and marine maps that are designed for navigation purposes are called:
A. Coordinates.
B. Sextants.
C. Charts.
D. Buoys.

153 On a scaled map, what increases as the denominator in the ration increases?
A. Detail
B. Land area
C. Numerator
D. Chart size

154 The navigational system that is widely used worldwide to guide ships and planes that are approaching the coast is:
A. VOR.
B. Loran.
C. Omega.
D. NAVSAT.

STOP HERE

Test Name: TRNSYC05
Scan Form: GPFORMS
Test Label:

Subtest Name	Number of Items	Number of Objectives	Starting Item Number
TRANS SYS COMPETENCY FIVE	154	5	1

Answer Key for TRANS SYS COMPETENCY FIVE

1)C	2)C	3)B	4)D	5)C	6)D	7)B	8)A
9)C	10)B	11)A	12)D	13)C	14)A	15)A	16)B
17)B	18)D	19)C	20)D	21)B	22)B	23)A	24)C
25)B	26)D	27)D	28)A	29)C	30)D	31)A	32)A
33)B	34)D	35)B	36)A	37)D	38)A	39)B	40)D
41)C	42)B	43)A	44)B	45)B	46)A	47)B	48)B
49)A	50)D	51)D	52)C	53)C	54)C	55)A	56)C
57)B	58)A	59)A	60)A	61)A	62)C	63)A	64)C
65)C	66)C	67)A	68)A	69)D	70)C	71)D	72)C
73)C	74)D	75)C	76)A	77)B	78)D	79)D	80)D
81)D	82)B	83)D	84)C	85)B	86)C	87)D	88)C
89)B	90)D	91)D	92)C	93)A	94)B	95)D	96)C
97)B	98)D	99)C	100)D	101)D	102)A	103)C	104)B
105)A	106)C	107)A	108)C	109)D	110)A	111)D	112)A
113)B	114)A	115)C	116)C	117)C	118)B	119)D	120)C
121)C	122)B	123)B	124)C	125)C	126)A	127)C	128)D
129)D	130)A	131)B	132)D	133)D	134)B	135)B	136)B
137)C	138)D	139)A	140)C	141)C	142)D	143)C	144)C
145)A	146)D	147)C	148)A	149)A	150)D	151)C	152)C
153)B	154)C						

Test Name: TRNSYC05
Scan Form: GPFORMS
Test Label:

Item Codes for TRANS SYS COMPETENCY FIVE

1)005.01.35	2)005.01.30	3)005.01.41	4)005.01.31
5)005.01.04	6)005.01.53	7)005.01.49	8)005.01.24
9)005.01.07	10)005.01.43	11)005.01.36	12)005.01.12
13)005.01.13	14)005.01.27	15)005.01.01	16)005.01.57
17)005.01.32	18)005.01.18	19)005.01.02	20)005.01.39
21)005.01.59	22)005.01.22	23)005.01.52	24)005.01.28
25)005.01.21	26)005.01.06	27)005.01.47	28)005.01.40
29)005.01.38	30)005.01.51	31)005.01.05	32)005.01.10
33)005.01.33	34)005.01.34	35)005.01.08	36)005.01.58
37)005.01.50	38)005.01.03	39)005.01.54	40)005.01.29
41)005.01.16	42)005.01.26	43)005.01.19	44)005.01.55
45)005.01.45	46)005.01.42	47)005.01.46	48)005.01.48
49)005.01.14	50)005.01.20	51)005.01.09	52)005.01.11
53)005.01.37	54)005.01.25	55)005.01.44	56)005.01.17
57)005.01.23	58)005.01.15	59)005.01.56	60)005.03.04
61)005.03.20	62)005.03.19	63)005.03.01	64)005.03.08
65)005.03.15	66)005.03.17	67)005.03.05	68)005.03.09
69)005.03.21	70)005.03.22	71)005.03.12	72)005.03.13
73)005.03.18	74)005.03.25	75)005.03.16	76)005.03.07
77)005.03.10	78)005.03.14	79)005.03.11	80)005.03.06
81)005.03.02	82)005.03.03	83)005.03.24	84)005.03.23
85)005.04.07	86)005.04.02	87)005.04.12	88)005.04.04
89)005.04.18	90)005.04.03	91)005.04.11	92)005.04.05
93)005.04.08	94)005.04.20	95)005.04.01	96)005.04.09
97)005.04.21	98)005.04.17	99)005.04.06	100)005.04.19
101)005.04.14	102)005.04.13	103)005.04.15	104)005.04.10
105)005.04.16	106)005.05.07	107)005.05.06	108)005.05.01
109)005.05.13	110)005.05.03	111)005.05.22	112)005.05.12
113)005.05.10	114)005.05.08	115)005.05.11	116)005.05.09
117)005.05.14	118)005.05.05	119)005.05.02	120)005.05.16
121)005.05.15	122)005.05.24	123)005.05.23	124)005.05.18
125)005.05.21	126)005.05.17	127)005.05.04	128)005.05.20
129)005.05.19	130)005.02.19	131)005.02.11	132)005.02.03
133)005.02.10	134)005.02.06	135)005.02.20	136)005.02.14
137)005.02.25	138)005.02.23	139)005.02.18	140)005.02.09
141)005.02.12	142)005.02.02	143)005.02.16	144)005.02.07
145)005.02.13	146)005.02.22	147)005.02.04	148)005.02.21
149)005.02.24	150)005.02.08	151)005.02.15	152)005.02.01
153)005.02.17	154)005.02.05		

Objective Labels for TRANS SYS COMPETENCY FIVE

1)5.01A EXP PROPULSION CONCEPTS	2)5.03A EXP CONTROL CONCEPTS
3)5.04A EXP SUSPENSION CONCEPTS	4)5.05A EXP STRUCTURAL CONCEPTS
5)5.02A EXP GUIDANCE CONCEPTS	

Test Name: TRNSYC05
Scan Form: GPFORMS
Test Label:

Objective Codes for TRANS SYS COMPETENCY FIVE

1)005.01A for 5.01A EXP PROPULSION CONCEPTS
2)005.03A for 5.03A EXP CONTROL CONCEPTS
3)005.04A for 5.04A EXP SUSPENSION CONCEPTS
4)005.05A for 5.05A EXP STRUCTURAL CONCEPTS
5)005.02A for 5.02A EXP GUIDANCE CONCEPTS

Number of Items Measuring each TRANS SYS COMPETENCY FIVE Objective

1) 59 in 5.01A EXP PROPULSION CONCEPTS
2) 25 in 5.03A EXP CONTROL CONCEPTS
3) 23 in 5.04A EXP SUSPENSION CONCEPTS
4) 22 in 5.05A EXP STRUCTURAL CONCEP
5) 25 in 5.02A EXP GUIDANCE CONCEPTS

Items Measuring TRANS SYS COMPETENCY FIVE 5.01A EXP PROPULSION CONCEPTS

1) 1	2) 2	3) 3	4) 4	5) 5	6) 6	7) 7	8) 8
9) 9	10) 10	11) 11	12) 12	13) 13	14) 14	15) 15	16) 16
17) 17	18) 18	19) 19	20) 20	21) 21	22) 22	23) 23	24) 24
25) 25	26) 26	27) 27	28) 28	29) 29	30) 30	31) 31	32) 32
33) 33	34) 34	35) 35	36) 36	37) 37	38) 38	39) 39	40) 40
41) 41	42) 42	43) 43	44) 44	45) 45	46) 46	47) 47	48) 48
49) 49	50) 50	51) 51	52) 52	53) 53	54) 54	55) 55	56) 56
57) 57	58) 58	59) 59					

Items Measuring TRANS SYS COMPETENCY FIVE 5.03A EXP CONTROL CONCEPTS

1) 60	2) 61	3) 62	4) 63	5) 64	6) 65	7) 66	8) 67
9) 68	10) 69	11) 70	12) 71	13) 72	14) 73	15) 74	16) 75
17) 76	18) 77	19) 78	20) 79	21) 80	22) 81	23) 82	24) 83
25) 84							

Items Measuring TRANS SYS COMPETENCY FIVE 5.04A EXP SUSPENSION CONCEPTS

1) 85	2) 86	3) 87	4) 88	5) 89	6) 90	7) 91	8) 92
9) 93	10) 94	11) 95	12) 96	13) 97	14) 98	15) 99	16)100
17)101	18)102	19)103	20)104	21)105	22)106	23)107	

Items Measuring TRANS SYS COMPETENCY FIVE 5.05A EXP STRUCTURAL CONCEPTS

1)108	2)109	3)110	4)111	5)112	6)113	7)114	8)115
9)116	10)117	11)118	12)119	13)120	14)121	15)122	16)123
17)124	18)125	19)126	20)127	21)128	22)129		

Test Name: TRNSYC05
Scan Form: GPFORMS
Test Label:

Items Measuring TRANS SYS COMPETENCY FIVE 5.02A EXP GUIDANCE CONCEPTS

1)130	2)131	3)132	4)133	5)134	6)135	7)136	8)137
9)138	10)139	11)140	12)141	13)142	14)143	15)144	16)145
17)146	18)147	19)148	20)149	21)150	22)151	23)152	24)153
25)154							

Mastery Level for TRANS SYS COMPETENCY FIVE Objectives

1) 44 out of 59 for 5.01A EXP PROPULSION CONCEPTS
2) 19 out of 25 for 5.03A EXP CONTROL CONCEPTS
3) 17 out of 23 for 5.04A EXP SUSPENSION CONCEPTS
4) 17 out of 22 for 5.05A EXP STRUCTURAL CONCEPTS
5) 19 out of 25 for 5.02A EXP GUIDANCE CONCEPTS

Partial Level for TRANS SYS COMPETENCY FIVE Objectives

1) 35 out of 59 for 5.01A EXP PROPULSION CONCEPTS
2) 15 out of 25 for 5.03A EXP CONTROL CONCEPTS
3) 14 out of 23 for 5.04A EXP SUSPENSION CONCEPTS
4) 13 out of 22 for 5.05A EXP STRUCTURAL CONCEPTS
5) 15 out of 25 for 5.02A EXP GUIDANCE CONCEPTS

DIRECTIONS FOR MULTIPLE-CHOICE ITEMS: Read each of the following multiple-choice items and the possible answers carefully. Mark the letter of the correct answer on your answer sheet or as instructed by your teacher. **REMEMBER: MAKE NO MARKS ON THIS TEST.**

1 Which of the following is used to increase the fuel efficiency of automobiles?
A. Lighter materials
B. Computers
C. Vortex generators
D. All of the above

2 You are designing a CO_2 powered race car. Generally, which of the following will most directly effect its speed?
A. Weight
B. Shape
C. Finish
D. Type wheels

3 Which one of the following design concepts would NOT be considered when building and evaluating a land transportation vehicle?
A. Drag
B. Weight
C. Buoyancy
D. Shape

4 You are riding your 10 speed (2 front sprockets, 5 back sprockets) bike on level ground, which combination of sprockets would enable you to go the fastest?
A. Small front, smallest back
B. Small front, largest back
C. Large front, smallest back
D. Large front, largest back

5 MagLev vehicles are suspended by:
A. Rails.
B. Electrical current traveling through the third track.
C. Magnetic force fields.
D. Magnetic wheels.

6 The propulsion system of a CO_2 car consists of a/n:
A. Electro-magnetic computerized launching system.
B. CO_2 cartridge.
C. String and screw-eye.
D. Axles and wheels.

7 When 40 foot-pounds of torque are produced at 3,200 r/min, how many horsepower are being produced?
A. 24.37
B. 48.70
C. 80
D. 128,000

GO TO NEXT PAGE

8 For a vehicle driven by a motor turning at a constant rpm, which of the following would result in the greatest pulling power?
A. A driving wheel attached to a small gear driven by a large gear directly connected to the motor
B. A driving wheel attached to a large gear driven by a small gear directly connected to the motor
C. A driving wheel attached to a small gear driven by a small gear directly connected to the motor
D. A driving wheel attached to a large gear driven by a large gear directly connected to the motor

9 For a vehicle driven by a motor turning a constant rpm, which of the following would result in the fastest speed?
A. A drive wheel directly connected to a small gear driven by a large gear connected to the motor
B. A drive wheel directly connected to a large gear driven by a small gear connected to the motor
C. A drive wheel directly connected to a large gear driven by one of the same size connected to the motor
D. A drive wheel directly connected to a small gear driven by one of the same size connected to the motor

10 The guidance system for CO_2 cars being raced consists of a/n:
A. CO_2 cartridge.
B. String and screw-eye.
C. Track.
D. Electro-magnetic computerized launcher.

11 To direct the airflow around a car to increase its efficiency, what may be placed on the roof of the car?
A. Bearings
B. Small fins
C. Vortexes
D. Thermal shields

12 The term active suspension refers to:
A. Fuel suspension processes.
B. Vehicle body designs.
C. Computer controlled suspension systems.
D. High tech shock absorbers.

13 Magnetic levitation vehicles are suspended on a magnetic field and propelled by:
A. Electric motors.
B. Diesel engines.
C. Jet turbines.
D. Propulsion magnets.

14 To increase efficiency in automobiles, it is best to design car bodies which have:
A. High drag indexes.
B. Low drag indexes.
C. A low coefficient of drag.
D. A high coefficient of drag.

GO TO NEXT PAGE

15 The suspension system of a CO^2 car consists of:
A. A car body.
B. Two screw-eyes.
C. A CO^2 cartridge.
D. Axles and wheels.

16 When designing a CO^2 powered race car, one should polish the axles to:
A. Reduce wheel wear.
B. Reduce friction caused by the axles rubbing against the bearings.
C. Make the look more professional.
D. Decrease the coefficient of drag on the car.

17 You are riding your 10 speed (2 front sprockets. 5 back sprockets) bike up a long hill. Which combination of sprockets would allow you do go the slowest?
A. Small front, smallest back
B. Small front, largest back
C. Large front, smallest back
D. Large front, largest back

18 The structural system of a CO^2 car consists of:
A. A car body.
B. CO^2 Cartridge.
C. Wheels and axles.
D. Screw-eyes.

19 Solar-powered vehicles are being required in some cities because they:
A. Are more fuel efficient.
B. Are faster.
C. Result in less air pollution.
D. Are safer.

20 In the design of automobiles, it is best to design cars which generate:
A. No vortex.
B. A vortex.
C. A high degree of drag.
D. Minimum torque.

21 Maglev rail systems contain magnets:
A. Located on the train only.
B. Located on the track (guideway) only.
C. Located on both the train and the track (guideway).
D. Which have north poles only.

22 A vehicles's operation through wind at high speeds may be simulated in a:
A. Speed chamber.
B. Highway environment simulator.
C. Wind tunnel.
D. Pressurized reactor.

GO TO NEXT PAGE

DIRECTIONS FOR PERFORMANCE ITEMS See your teacher or test administrator for instructions on completing the following performance item(s).

23 The purpose of this activity is to design and build the highest quality simple land transportation vehicle model you are capable of developing by applying the skills, knowledge, and insights learned through your research, experimentation, and evaluation.

Individually or as a member of a team, design, build, and evaluate a simple land transportation vehicle model. Using information previously learned from your research and experimentation, including any necessary addition research, design a simple land transportation vehicle then build the model (graphical, physical, or computer generated) to the appropriate scale and specifications as indicated in your design criteria. Finally evaluate and test your model to see that it functions appropriately. Use the specific guidelines provided by your teacher throughout the process. Demonstrate your model to the class.

You will be assessed using the following criteria:

	Points
I. Design (Well researched and thought out) (Includes necessary drawings, specifications, and design criteria).	0-25
II. Model	
Artisanship (Quality and appropriateness of construction	0-25
Efficacy (Works well and as planned, efficient)	0-25
III. Evaluation (Thorough and well thought out, discusses relevant aspects of model's performance)	0-15
IV. Demonstration (Model performs as expected, presenter gives clear description and explanation of model's functions)	0-10
Total Possible Score	0-100 points

STOP HERE

Directions for Item 23

For this activity help the students develop the highest quality simple land transportation project they can design and execute. Work to ensure that they use their skills, knowledge, and insights gained from their previous experimentation and research in the design of their model. The model does not have to be physical such as a CO_2, maglev, or mouse-trap car or other device. It may be graphical, electronic, or computer generated. Ask yourself the purpose of the activity. Does it demand the use of the students' analytical and creative skills as well as well as allow them to apply the technical and scientific information they have already learned about transportation systems and subsystems? Does the activity add to a more complex understanding of transportation systems? Finally, if the student(s) are going on to Advanced Transportation Systems, will this activity lead in this direction? Is what they will learn here fundamental and essential to what they will need to know to be successful with a more complicated and demanding study?

Scoring Directions for Test Item 23 Unit 1 Key 23

The purpose of this activity is to have the students continue their research into appropriate land transportation vehicular systems, and design, build, and evaluate a simple land transportation model. Note that the model may be graphical, computer generated, or physical. The student(s) should demonstrate his/their model to the rest of the class. Evaluation should focus on the application of scientific and technical skills as well as the efficacy of their models. As noted below the students will also be assessed on the quality of their demonstration.

Assess the students using the following criteria or modify appropriately:

	Points
I. Design (Well researched and thought out) (Includes the necessary drawings with correct specifications and design criteria)	0-25
II. Model	
Artisanship (Quality and appropriateness of construction)	0-25
Efficacy (Works well and as planned)	0-25
III. Evaluation (Thorough and well thought out, discusses relevant aspects of model's performance and uses scientific and technical terms correctly)	0-15
IV Demonstration (Model performs as expected, presenter gives clear description and explanation of model's performance and functions)	0-10
Total Possible Score	0-100 points

Test Name: TRNSYC06
Scan Form: GPFORMS
Test Label:

Subtest Name	Number of Items	Number of Objectives	Starting Item Number
TRANS SYS COMPETENCY SIX	23	2	1

Answer Key for TRANS SYS COMPETENCY SIX

1)D	2)A	3)C	4)C	5)C	6)B	7)A	8)C
9)A	10)B	11)B	12)C	13)D	14)C	15)D	16)B
17)B	18)A	19)C	20)B	21)C	22)C	23)S	

Item Codes for TRANS SYS COMPETENCY SIX

1)006.01.05	2)006.01.15	3)006.01.01	4)006.01.13
5)006.01.22	6)006.01.19	7)006.01.02	8)006.01.12
9)006.01.11	10)006.01.17	11)006.01.04	12)006.01.10
13)006.01.08	14)006.01.07	15)006.01.20	16)006.01.16
17)006.01.14	18)006.01.21	19)006.01.09	20)006.01.06
21)006.01.18	22)006.01.03	23)006.02.01	

ective Labels for TRANS SYS COMPETENCY SIX

1)6.01A EXP LAND TRANS DESIGN 2)DESIGN/BUILD LAND TRANS MODEL

Objective Codes for TRANS SYS COMPETENCY SIX

1)006.01A	for 6.01A EXP LAND TRANS DESIGN
2)006.02	for DESIGN/BUILD LAND TRANS MODEL

Number of Items Measuring each TRANS SYS COMPETENCY SIX Objective

1) 22 in 6.01A EXP LAND TRANS DESIGN 2) 1 in DESIGN/BUILD LAND TRANS MOD

Items Measuring TRANS SYS COMPETENCY SIX 6.01A EXP LAND TRANS DESIGN

1) 1	2) 2	3) 3	4) 4	5) 5	6) 6	7) 7	8) 8
9) 9	10) 10	11) 11	12) 12	13) 13	14) 14	15) 15	16) 16
17) 17	18) 18	19) 19	20) 20	21) 21	22) 22		

Test Name: TRNSYC06
Scan Form: GPFORMS
Test Label:

Items Measuring TRANS SYS COMPETENCY SIX DESIGN/BUILD LAND TRANS MODEL

1) 23

Mastery Level for TRANS SYS COMPETENCY SIX Objectives

1) 17 out of 22 for 6.01A EXP LAND TRANS DESIGN
2) 1 out of 1 for DESIGN/BUILD LAND TRANS MODEL

Partial Level for TRANS SYS COMPETENCY SIX Objectives

1) 13 out of 22 for 6.01A EXP LAND TRANS DESIGN
2) 1 out of 1 for DESIGN/BUILD LAND TRANS MODEL

DIRECTIONS FOR MULTIPLE-CHOICE ITEMS: Read each of the following multiple-choice items and the possible answers carefully. Mark the letter of the correct answer on your answer sheet or as instructed by your teacher. **REMEMBER: MAKE NO MARKS ON THIS TEST.**

1 The advantage of hydrofoils in hull design is that:
A. They have great stability in storms and are nearly impossible to sink.
B. They offer great control at low speeds and large cargo storage.
C. Fishermen find them excellent for trolling.
D. The foils offer much less drag than conventional hulls.

2 Assuming 100% efficiency with no drag or friction, if a propeller on a boat turns 3,800 rpm's, and the boat moves forward at 57,000 inches per minute, what is the propeller's pitch?
A. .06
B. 9
C. 15
D. 21

3 All else being equal, the greater a sailboat's draft, the:
A. Faster it will go.
B. Slower it will go.
C. More it can carry.
D. Less it can carry.

4 A marine vessel's propeller has a pitch of 17 and turns at 4,200 rpm. Assuming 100% efficiency, approximately how far would the boat move in one minute?
A. 100 ft
B. 100 yds
C. 1/2 mile
D. 1 mile

5 Generally, the greater the surface area to water of a boat, the:
A. Greater the drag.
B. The less the drag.
C. The less buoyancy.
D. The greater its speed.

6 Sailboats designed with deep hulls help:
A. Increase the boats speed.
B. Increase the boats turning radius.
C. Stabilize the boat in rough seas.
D. Reduce the boat's buoyancy.

7 A small boat displaces 10 cubic feet of water. Four people, together weighing 650 lbs, want to row across the sound. What will happen? (Note the water weighs approximately 64 lbs. per cubic feet).
A. The boat will sink.
B. The boat will not sink.
C. The boat will be more stable with four people than one person.
D. Displacement has nothing to do with whether they will make it across the sound.

GO TO NEXT PAGE

8 The advantage of double-hull design on ships is that it:
A. Increases buoyancy.
B. Helps increase the ships speed.
C. Lessens the drag on the hull.
D. Lessens the likelihood of sinking.

9 The sail of a sailboat works much like a/n:
A. Rocket engine.
B. Hot air balloon.
C. Wing on an airplane.
D. Internal combustion engine.

10 When designing a sailboat, to increase its buoyancy, one would:
A. Increase its weight.
B. Increase its displacement.
C. Increase the square feet area of the sail(s).
D. Increase its ballast.

11 When building a water transportation vehicle, which one of the following would be considered during the design stage?
A. Thrust
B. Lift
C. Moor
D. Draft

12 A cruising sailboat will have:
A. Low pressure on the windward side of it main sail.
B. Low pressure on the windward side of its spinnaker.
C. High pressure on the windward side of its main sail.
D. High pressure on its starboard side.

13 Generally, a boat built for speed will have a:
A. Flat bow.
B. Round bow.
C. Square bow.
D. Pointed bow.

14 If you wished to design a small fresh water fishing boat, which hull shape would most likely meet your needs?
A. Round
B. Flat
C. Square
D. Triangular

15 A solid steel ball will sink in water because:
A. It is harder than water.
B. It is a solid, not a liquid.
C. It displaces less water than it weighs.
D. It displace more water than it weighs.

GO TO NEXT PAGE

16 Generally, wide flat hulls are:
A. Designed for speed and to carry great weight.
B. Designed to carry great weight but tend to generate great drag.
C. Designed for speed and light cargos.
D. Designed to carry great weight but tend to be unstable.

17 A chine is designed to:
A. Increase the speed of a boat.
B. Pull in nets on a fishing boat.
C. Secure a vessel to a mooring.
D. Reduce the rolling and splashing of a boat.

DIRECTIONS FOR PERFORMANCE ITEMS See your teacher or test administrator for instructions on completing the following performance item(s).

18 The purpose of this activity is to design and build the highest quality simple water transportation vehicle model you are capable of developing by applying the skills, knowledge, and insights learned through your research, experimentation, and evaluation.

Individually or as a member of a team, design, build, and evaluate a simple water transportation vehicle model. Using information previously learned from your research and experimentation, including any necessary addition research, design a simple water transportation vehicle. Then build the model (graphical, physical, or computer generated) to the appropriate scale and specifications as indicated in your design criteria. Finally evaluate and test your model to see that it functions appropriately. Use the specific guidelines provided by your teacher throughout the process. Demonstrate your model to the class.

You will be assessed using the following criteria:

		Points
I.	Design (Well researched and thought out. Includes necessary drawings, specifications, and design criteria.)	0-25
II.	Model	
	Artisanship (Quality and appropriateness construction)	0-25
	Efficacy (Works well and as planned)	0-25
III.	Evaluation (Thorough and well though out, discusses relevant aspects of model's design, construction, and performance)	0-15
IV.	Demonstration (Model performs as expected, presenter gives clear description and explanation of model's development and functions)	0-10
	Total Possible Score	0-100 points

STOP HERE

Directions for Item 18

For this activity you are to help the students develop the highest quality simple water transportation vehicular model they can design and execute. Work to ensure that they use their skills, knowledge, and insights gained from their previous experimentation and research in the design of their model. The model does not have to be physical such as a motor or sail boat or other device. It may be graphical, electronic, or computer generated. To help determine the worth of a student(s)' project, ask yourself the purpose of the activity. Does it demand the use of the student(s') analytical and creative skills as well as allow them to apply the technical and scientific information they have already learned related to transportation systems and subsystems? Does the activity add to a more complex and through understanding of transportation systems? Finally, if the student(s) are going on to Advanced Transportation Systems, will this activity lead in this direction? In other words, is what they will learn here fundamental and essential to what they will need to know to be successful with a more complicated and demanding study?

GO TO NEXT PAGE

Scoring Directions for Test Item 18 Unit 1 Key 18

The purpose of this activity is to have the students continue their research into appropriate water transportation systems and design, build, and evaluate a simple water transportation vehicular model. This model may be graphical, computer generated or physical. The students should demonstrate their model to the rest of the class. Evaluation should focus on the application of scientific and technical skills as well as the artisanship of the students and the efficacy of their models. As noted below the students will also receive credit for their demonstration.

Assess the students using the following criteria or modify appropriately:

		Points
I.	Design (Well researched and thought out. Includes the necessary drawings, with correct specifications and design criteria)	0-25
II.	Model	
	Artisanship (Quality and appropriateness of construction)	0-25
	Efficacy (Works well and as planned)	0-25
III.	Evaluation (Thorough and well thought out. Discusses relevant aspects of model's performance and uses scientific and technical terms correctly)	0-15
IV.	Demonstration (Model performs as expected, presenter gives clear description and explanation of model's performance and functions)	0-10
	Total Possible Score	0-100 points

Test Name: TRNSYC07
Scan Form: GPFORMS
Test Label:

Subtest Name	Number of Items	Number of Objectives	Starting Item Number
TRANS SYS COMPETENCY SEVEN	18	2	1

Answer Key for TRANS SYS COMPETENCY SEVEN

1)D	2)C	3)B	4)D	5)A	6)C	7)A	8)D
9)C	10)B	11)D	12)C	13)D	14)B	15)C	16)B
17)D	18)S						

Item Codes for TRANS SYS COMPETENCY SEVEN

1)007.01.09	2)007.01.02	3)007.01.13	4)007.01.03
5)007.01.05	6)007.01.15	7)007.01.06	8)007.01.16
9)007.01.11	10)007.01.12	11)007.01.01	12)007.01.10
13)007.01.17	14)007.01.14	15)007.01.07	16)007.01.08
17)007.01.04	18)007.02.01		

Objective Labels for TRANS SYS COMPETENCY SEVEN

1)7.01A EXP WATER TRAN DESIGN 2)DESIGN/BUILD WATER TRANS MODEL

Objective Codes for TRANS SYS COMPETENCY SEVEN

1)007.01A	for 7.01A EXP WATER TRAN DESIGN
2)007.02	for DESIGN/BUILD WATER TRANS MODEL

Number of Items Measuring each TRANS SYS COMPETENCY SEVEN Objective

1) 17 in 7.01A EXP WATER TRAN DESIGN 2) 1 in DESIGN/BUILD WATER TRANS MO

Items Measuring TRANS SYS COMPETENCY SEVEN 7.01A EXP WATER TRAN DESIGN

1) 1	2) 2	3) 3	4) 4	5) 5	6) 6	7) 7	8) 8
9) 9	10) 10	11) 11	12) 12	13) 13	14) 14	15) 15	16) 16
17) 17							

Items Measuring TRANS SYS COMPETENCY SEVEN DESIGN/BUILD WATER TRANS MODEL

1) 18

Test Name: TRNSYC07
Scan Form: GPFORMS
Test Label:

Mastery Level for TRANS SYS COMPETENCY SEVEN Objectives

1) 13 out of 17 for 7.01A EXP WATER TRAN DESIGN
2) 1 out of 1 for DESIGN/BUILD WATER TRANS MODEL

Partial Level for TRANS SYS COMPETENCY SEVEN Objectives

1) 10 out of 17 for 7.01A EXP WATER TRAN DESIGN
2) 1 out of 1 for DESIGN/BUILD WATER TRANS MODEL

DIRECTIONS FOR MULTIPLE-CHOICE ITEMS: Read each of the following multiple-choice items and the possible answers carefully. Mark the letter of the correct answer on your answer sheet or as instructed by your teacher. **REMEMBER: MAKE NO MARKS ON THIS TEST.**

1 When turbulence on the top of an airfoil reduces lift to such a degree that the lift can no longer support the craft:
A. A state of stall has been reached.
B. Aerodynamic balance has been reached.
C. Drag has been eliminated.
D. Mach one has been reached.

2 For a plane to bank, it will use its:
A. Landing gear.
B. Flaps and elevators.
C. Rudder and ailerons.
D. Emergency evacuation chute.

3 A wing having a span of 30 feet and a cord of 5 feet would have an aspect ratio of:
A. 3.
B. 6.
C. 10.
D. 150.

4 To design a plane which has excellent stall characteristics, one would choose a:
A. Straight wing.
B. Tapered wing.
C. Elliptical wing.
D. Sweptback or delta wing.

5 The aspect ratio refers to the:
A. Angle a plane cuts through the air compared to its thrust.
B. Ratio of a wings span to its chord.
C. Ratio of a ships weight to what it can carry.
D. Ratio of a rockets angle of re-entry to its loss of altitude.

6 Hot air balloons float in air much like boats in water. What is the primary propulsion for hot air balloons?
A. Released hot air
B. Propeller(s)
C. Aileron(s)
D. Wind

7 A hot air balloon floats because:
A. Heat always goes up.
B. The unequal pressure on the bottom of the balloon forces it up.
C. The air on the outside of the balloon is more dense than the air on the inside.
D. The helium used is lighter than air.

GO TO NEXT PAGE

8 Gliders are powered by:
A. Wankel or two-stoke engines.
B. Diesel engines.
C. Solar powered motors.
D. Wind currents and gravity.

9 The higher the aspect ratio the:
A. Higher the plane's drag.
B. Greater the wing's efficiency.
C. Greater the tonnage the ship can carry.
D. Faster the rockets re-entry speed.

10 The most efficient wing is the:
A. Elliptical wing.
B. Straight wing.
C. Sweptback wing.
D. Tapered wing.

11 One method for reducing wing vortices is to:
A. Lower the aspect ratio.
B. Decrease fuel consumption.
C. Use a larger tail section.
D. Use winglets.

12 The upper chamber must have more curvature, and therefore more surface area than the lower chamber in order to:
A. Provide lift on the top of the wing.
B. Provide thrust during initial take-off.
C. Provide better ballast and less drag.
D. Decrease the fuel pressure as the fuel leaves the lower chamber of the engine.

13 The wing having excellent stall characteristics and economical to build is the:
A. Elliptical wing.
B. Straight wing.
C. Sweptback wing.
D. Tapered wing.

14 Model rockets are powered by:
A. Inert gas jets.
B. Solid-fuel engines.
C. Liquid-fuel engines.
D. Pneumatic engines.

15 Flaps are designed to:
A. Increase the buoyancy of boats.
B. Increase the lift of a wing.
C. Apply drag to a rocket.
D. Apply directional thrust on a rocket.

GO TO NEXT PAGE

16 Kites and planes can fall from the sky when the angle of attack becomes so steep that they:
A. Dive.
B. Break apart.
C. Stall.
D. Decline.

17 If your model rocket engine produces 8.896 newtons of force, how many pounds of thrust are produced?
A. 1
B. 2
C. 20
D. 100

18 The design and making of a space vehicle's propulsion system apply which of the following laws?
A. Newtons First, Second, and Third Laws of Motion
B. Ohm's Laws of Thrust and Pressure
C. Nelson's Laws of Stability
D. Bernoulli's Theorems of Motion and Propulsion

19 The plane which is most efficient from structural, weight, and drag standpoints would have:
A. Straight wings.
B. Tapered wings.
C. Elliptical wings.
D. Sweptback or delta wings.

20 The Voyager had a wing span of more than 110 feet and a chord of about 3 feet. This plane had an excellent:
A. Camber.
B. Chord line
C. Aspect ratio.
D. Differential.

21 The upper chamber and lower chamber refers to:
A. Parts of a ship hull.
B. Parts of an Wankel engine.
C. Parts of a rocket engine.
D. Parts of a wing.

GO TO NEXT PAGE

DIRECTIONS FOR PERFORMANCE ITEMS See your teacher or test administrator for instructions on completing the following performance item(s).

22 The purpose of this activity is to design and build the highest quality simple air or space transportation model you are capable of developing by applying the skills, knowledge, and insights learned through your research, experimentation, and evaluation.

Individually or as a member of a team, design, build, and evaluate a simple air or space transportation model. Using information previously learned from your research and experimentation, including any necessary addition research, design a simple air or space transportation model, then build the model (graphical, physical, or computer generated) to the appropriate scale and specifications as dictated by your design criteria. Finally evaluate and test your model to see that it functions appropriately. Use the specific guidelines provided by your teacher throughout the process. Demonstrate your model to the class.

You will be assessed using the following criteria:

		Points
I.	Design (Well researched and though out. Includes necessary drawings, specifications, and design criteria).	0-25
II.	Model	
	Artisanship (Quality and appropriateness of construction)	0-25
	Efficacy (Works well and as planned, efficient)	0-25
III.	Evaluation (Thorough and well though out, discusses relevant aspects of model's design, construction, and performance)	0-15
IV.	Demonstration (Model performs as expected, presenter gives clear description and explanation of models development and functions)	0-10
	Total Possible Score	0-100 points

STOP HERE

Directions for Item 22

Help the students develop the highest quality simple air or space transportation vehicle model they can design and execute. Work to ensure that they use their skills, knowledge, and insights gained from their previous experimentation and research in the design of their model. The model does not have to be physical such as a glider or simple model rocket. It may be graphical, electronic, or computer generated. Ask yourself the purpose of the activity. Does it demand the use of the students' analytical and creative skills as well as allow them to apply the technical and scientific information they have already learned about transportation systems and subsystems? Finally, if the student(s) are going on to Advanced Transportation Systems, will this activity lead in this direction? Is what they will learn here fundamental and essential to what they will need to know to be successful in a more complicated and demanding study?

GO TO NEXT PAGE

Scoring Directions for Test Item 22 Unit 1 Key 22

The purpose of this activity is to have the students continue their research into appropriate air or space transportation systems and design, build, and evaluate a simple air or space transportation vehicular model. This model may be graphical, computer generated or physical. The students should demonstrate their model to the rest of the class. Evaluation should focus on the application of scientific and technical skills as well as the artisanship of the students and the efficacy of their models. As noted below the students will also be assessed on the quality of their demonstration.

Assess the students using the following criteria or modify appropriately:

		Points
I.	Design (Well researched and thought out. Includes the necessary drawings with correct specifications and design criteria)	0-25
II.	Model	
	Artisanship (Quality and appropriateness of construction)	0-25
	Efficacy (Works well and as planned)	0-25
III.	Evaluation (Thorough and well though out, discusses relevant aspects of model's design, construction, and performance).	0-15
IV.	Demonstration (Model performs as expected, presenter gives clear description and explanation of model's functions).	0-10
	Total Possible Score	0-100 points

Test Name: TRNSYC08
Scan Form: GPFORMS
Test Label:

Subtest Name	Number of Items	Number of Objectives	Starting Item Number
TRANS SYS COMPETENCY EIGHT	22	2	1

Answer Key for TRANS SYS COMPETENCY EIGHT

1)A	2)C	3)B	4)A	5)B	6)D	7)C	8)D
9)B	10)A	11)D	12)A	13)B	14)B	15)B	16)C
17)B	18)A	19)C	20)C	21)D	22)S		

Item Codes for TRANS SYS COMPETENCY EIGHT

1)008.01.17	2)008.01.12	3)008.01.20	4)008.01.18
5)008.01.05	6)008.01.13	7)008.01.11	8)008.01.14
9)008.01.06	10)008.01.08	11)008.01.09	12)008.01.03
13)008.01.07	14)008.01.15	15)008.01.10	16)008.01.16
17)008.01.04	18)008.01.01	19)008.01.19	20)008.01.21
21)008.01.02	22)008.02.01		

Objective Labels for TRANS SYS COMPETENCY EIGHT

1)8.01A EXP AIR/SPACE TRAN DESIG 2)BUILD AIR OR SPACE MODEL

Objective Codes for TRANS SYS COMPETENCY EIGHT

1)008.01A	for 8.01A EXP AIR/SPACE TRAN DESIG
2)008.02	for BUILD AIR OR SPACE MODEL

Number of Items Measuring each TRANS SYS COMPETENCY EIGHT Objective

1) 21 in 8.01A EXP AIR/SPACE TRAN DESIG 2) 1 in BUILD AIR OR SPACE MODEL

Items Measuring TRANS SYS COMPETENCY EIGHT 8.01A EXP AIR/SPACE TRAN DESIG

1) 1	2) 2	3) 3	4) 4	5) 5	6) 6	7) 7	8) 8
9) 9	10) 10	11) 11	12) 12	13) 13	14) 14	15) 15	16) 16
17) 17	18) 18	19) 19	20) 20	21) 21			

Test Name: TRNSYC08
Scan Form: GPFORMS
Test Label:

Items Measuring TRANS SYS COMPETENCY EIGHT BUILD AIR OR SPACE MODEL

1) 22

Mastery Level for TRANS SYS COMPETENCY EIGHT Objectives

1) 16 out of 21 for 8.01A EXP AIR/SPACE TRAN DESIG
2) 1 out of 1 for BUILD AIR OR SPACE MODEL

Partial Level for TRANS SYS COMPETENCY EIGHT Objectives

1) 13 out of 21 for 8.01A EXP AIR/SPACE TRAN DESIG
2) 1 out of 1 for BUILD AIR OR SPACE MODEL

DIRECTIONS FOR MULTIPLE-CHOICE ITEMS: Read each of the following multiple-choice items and the possible answers carefully. Mark the letter of the correct answer on your answer sheet or as instructed by your teacher. **REMEMBER: MAKE NO MARKS ON THIS TEST.**

1 Aircraft preparing for take-off or just after landing are directed by:
A. Guidance personnel.
B. Traffic directors.
C. Air traffic controllers.
D. Ground controllers.

2 Aircraft mechanics and engine specialist need the following skills:
A. Analytical, artistic, communication, mathematical.
B. Scientific, artistic, communication, mathematical.
C. Analytical, artistic, mathematical, scientific.
D. Analytical, communication, mathematical, scientific.

3 Diesel mechanics need the following skills:
A. Analytical, mathematical, artistic, and great strength.
B. Analytical, mathematical, artistic, and scientific.
C. Analytical, mathematical, scientific, and communication.
D. Analytical, mathematical, scientific, and great strength.

4 The control of aircraft through the airways is done by:
A. The U.S. Airforce.
B. Air traffic controllers.
C. TWS operators.
D. ERIN in the United States.

5 Your aptitude towards a particular occupational field refers to:
A. How quickly you are able to learn a skill and grasp its concepts.
B. Those things that you are successful at doing.
C. The amount of formal and informal education you have obtained.
D. Whether or not you like or dislike a particular occupational area.

6 Aerospace engineers help produce commercial and military aircraft and have additional responsibilities of:
A. Designing.
B. Developing.
C. Testing.
D. All the above.

7 Skilled automotive mechanics can expect changes in the economy to:
A. Have little affect on employment opportunities.
B. Have a large affect on employment opportunities.
C. Decrease their salaries greatly.
D. Decrease automobile repair cost.

GO TO NEXT PAGE

8 During a recession air traffic controllers are:
A. Always laid off.
B. Never laid off.
C. Seldom laid off.
D. The most affected occupation.

9 An excellent place to learn more about transportation careers is the:
A. Newspaper.
B. Encyclopedia of Occupations.
C. Occupational Outlook Handbook.
D. Robert's Inventories.

10 Aircraft mechanics with experience can expect:
A. Limited job opportunities due to the decrease in airlines.
B. Fair job opportunities in the future.
C. Good job opportunities in the future.
D. Excellent job opportunities in the future.

DIRECTIONS FOR PERFORMANCE ITEMS See your teacher or test administrator for instructions on completing the following performance item(s).

11 The purpose of this activity is to assess your interest and abilities in relation to existing or emerging occupations within any area of the transportation industries.

As part of your Career Development Plan, review your interests, attributes, academic success, and your course of study in relation to the things you have done in this class. Research relevant career opportunities.

You may wish to reference the TSA Career and Personal Planning Activity found in the TSA Curricular Resource Guide.

Finally, prepare a brief written report on your findings and report these to the rest of your class. You will be evaluated using the following criteria:

	Points
I. Written Report	
Occupational Information (Includes occupation(s) of interest, responsibilities, characteristics, salary range, number of openings, and required skills).	0-25
Educational Requirement (Accurate and clear description of needed education and training).	0-25
Student's Interest (Explains persuasively how his/her talents and interest match the occupation under study).	0-25
II. Presentation (Clearly, persuasively, and interestingly presents the above information).	0-25
Total Possible Points	0-100

STOP HERE

Directions for Item 11

Have each student assess their interest and abilities in relation to an occupation within the transportation system industry. Have each student research an occupation of interest, assessing themselves in relation to their interest, attributes, past academic performance, and their present career development plan.

GO TO NEXT PAGE

Scoring Directions for Test Item 11 Unit 1 Key 11

Assess each student on how well he or she evaluates themselves (their apptitude, academic performance, interests, and course of study) in relationship to the transportation system careers he or she investigates. Is their assessment serious and honest? Does he or she have a good understanding of what is required in relation to their past performance and interests?

Assess each student using the following criteria or modify appropriately:

		Points
I.	Written Report	
	Occupational Information (Includes occupation(s) of interest, responsibilities, characteristics, salary range, number of openings, and required skills)	0-25
	Educational Requirements (Accurate and clear description of needed education and training)	0-25
	Student's Interest (Explains persuasively how his/her talents and interest match the occupation under study	0-25
II.	Presentation (Clearly, persuasively, and interestingly, presents the above information)	0-25
	Total Possible Points	0-100

GO TO NEXT PAGE

Test Name: TRNSYC09
Scan Form: GPFORMS
Test Label:

Subtest Name	Number of Items	Number of Objectives	Starting Item Number
TRANS SYS COMPETENCY NINE	11	2	1

Answer Key for TRANS SYS COMPETENCY NINE

1)D 2)D 3)C 4)B 5)A 6)D 7)A 8)C
9)C 10)D 11)S

Item Codes for TRANS SYS COMPETENCY NINE

1)009.01.01 2)009.01.07 3)009.01.03 4)009.01.06
5)009.01.05 6)009.01.02 7)009.01.10 8)009.01.08
9)009.01.04 10)009.01.09 11)009.02.01

Objective Labels for TRANS SYS COMPETENCY NINE

1)9.01A IDENT TRANS OCCUP OPPORT 2)ASSESS CAREER GOALS

Objective Codes for TRANS SYS COMPETENCY NINE

1)009.01A for 9.01A IDENT TRANS OCCUP OPPORT
2)009.02 for ASSESS CAREER GOALS

Number of Items Measuring each TRANS SYS COMPETENCY NINE Objective

1) 10 in 9.01A IDENT TRANS OCCUP OPPORT 2) 1 in ASSESS CAREER GOALS

Items Measuring TRANS SYS COMPETENCY NINE 9.01A IDENT TRANS OCCUP OPPORT

1) 1 2) 2 3) 3 4) 4 5) 5 6) 6 7) 7 8) 8
9) 9 10) 10

Items Measuring TRANS SYS COMPETENCY NINE ASSESS CAREER GOALS

1) 11

Test Name: TRNSYC09
Scan Form: GPFORMS
Test Label:

Mastery Level for TRANS SYS COMPETENCY NINE Objectives

1) 8 out of 10 for 9.01A IDENT TRANS OCCUP OPPORT
2) 1 out of 1 for ASSESS CAREER GOALS

Partial Level for TRANS SYS COMPETENCY NINE Objectives

1) 6 out of 10 for 9.01A IDENT TRANS OCCUP OPPORT
2) 1 out of 1 for ASSESS CAREER GOALS

Transportation Systems Formula Sheet

PITCH: The measure (in inches) of distance a propeller moves forward during each revolution

One newton = .224 pounds of force

One pound of force = 4.448 newtons

1 Hp = the energy needed to lift 33,000 lbs. 1 foot in 1 minute

1 knot = 1.151 land miles

$$\text{Horsepower} = \frac{\text{Torque} \times \text{rpm}}{5252}$$

1 mile = 5280 feet

$$\text{Efficiency} = \frac{\text{Energy out}}{\text{Energy in}} \times 100\,\%$$